VOLUME XXXI NUMBER 4

JOURNAL OF THE ARNOLD ARBORETUM

HARVARD UNIVERSITY

OCTOBER, 1950

PUBLISHED BY
THE ARNOLD ARBORETUM OF HARVARD UNIVERSITY
JAMAICA PLAIN, MASS.
1950

THE JOURNAL OF THE ARNOLD ARBORETUM

Published quarterly by the Arnold Arboretum of Harvard University.

Subscription price $7.00 per year. Price of single numbers $2.00.

Vols. I–XI out of print. Vols. XII–XIII: Price $3.00 each; single numbers $1.00 each. Vols. XIV—XXVIII: Price $4.00 each; single numbers $1.25 each. Vol. XXIX—XXXI: Price $7.00 each; single numbers $2.00 each.

Subscriptions and remittances should be addressed to the ARNOLD ARBORETUM, JAMAICA PLAIN, Massachusetts.

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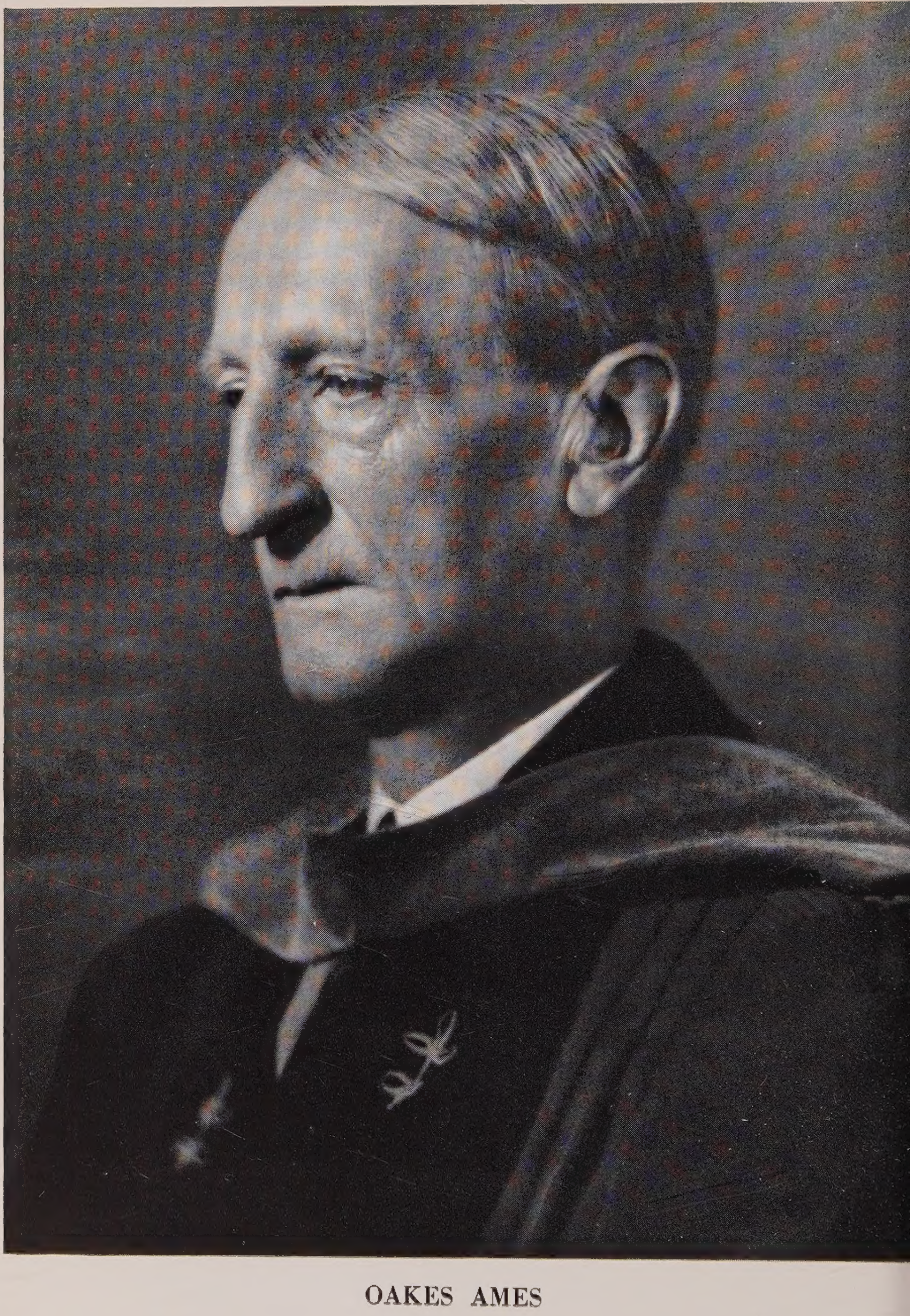
Entered as second class matter April 4, 1940, at the post office at Boston, Massachusetts, under the Act of August 24, 1912.



OAKES AMES

JOURNAL

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ARNOLD ARBORETUM

Vol. XXXI | OCTOBER 1950 | Number 4

OAKES AMES, 1874–1950

Oakes Ames, Supervisor of the Arnold Arboretum from 1927 to 1935, died in Ormond, Florida, on April 28th, at the age of 75 years. Memorial services were held at his home in North Easton on May 3rd. He is survived by his wife Blanche Ames, and his children, Oliver Ames of Beverly Farms, Mrs. Francis Plimpton of New York, Amyas Ames of Cold Spring Harbor, Long Island, New York, and Mrs. J. Pascall Davis of Nashville, Tennessee.

Professor Ames was born in North Easton on September 26, 1874, the son of Oliver Ames who later served as the Governor of Massachusetts. He was graduated from Harvard in 1898, and received his master's degree the following year. In 1938 he was awarded an honorary degree of Doctor of Science from Washington University.

Professor Ames' interest in botany developed early and as a student at Harvard there was no question regarding his future career. His interest in orchids led him to visit the famous orchid collections in Europe and later in his life he visited the tropics to study the tropical species in their native habitats. While still a young man he made a collection of living species of orchids which eventually became the most complete in this country.

The Orchid Herbarium which Professor Ames developed at Harvard numbers more than 64,000 specimens, including more than 1,000 species described by Professor Ames himself. An excellent library accompanies the orchid collections, together with photographs and paintings of the types in the Lindley Herbarium at Kew in England, and the Reichenbach Herbarium in Vienna. Included in this collection are the superb paintings and drawings of orchid species done by Mrs. Ames. This complete collection, with an endowment fund to provide for its maintenance, was given to Harvard University by Professor Ames in 1938.

In these days of specialization most botanists would have been content to master one field of botany. But under the influence of Professor George Lincoln Goodale, who for some years taught a course in economic botany, Professor Ames developed an interest in that subject which he maintained during the rest of his life. He first taught a course in economic

botany in 1909–10, followed a few years later by a series of lectures on medical botany in the Harvard School of Tropical Medicine. In 1916–17 he moved his collections to the Bussey Institution of Applied Biology, where he taught a course dealing with both economic botany and taxonomy.

From these beginnings developed the course in Economic Botany at Harvard — a course in "general education" dealing with taxonomy, economic plants, agriculture, plant geography and anthropology. Professor Ames in his travels had collected an amazing variety of economic plant specimens and plant products related to agriculture, medicine, industry and the arts. Accompanying these collections are detailed descriptions in the files, and a library of 16,000 pamphlets and books dealing with economic plants. These collections are the most complete in the field of economic botany to be found anywhere in the world.

Students who have worked in the Economic Botany herbarium will always remember the detailed descriptions of the various economic plants. The large index cards were filled with Professor Ames' fine script with no erasures and no alterations. Every description was complete, orderly and precise. Apparently every item in the collection received his personal attention, yet he was able to integrate his work with the broader aspects of biology.

Professor Ames, in dealing with both orchids and economic plants, was not content with mere description and cataloguing. In his book "Economic Annuals and Human Cultures," published in 1939, he dealt with the antiquity of agriculture. He presented evidence to show that plants were brought into cultivation much earlier than is generally supposed. It is also evident from this book that Professor Ames recognized agriculture as the foundation of civilization.

Seldom in Harvard history has one man been called to fill so many important posts: Assistant Director of the Botanic Garden, 1899–1909; Instructor in Botany, 1900–1910; Director of the Botanic Garden, 1909–1922; Assistant Professor of Botany, 1915–1926; Curator of the Botanical Museum, 1923–1927; Professor of Botany, 1926–1932; Chairman of the Division of Biology, 1926–1935; Chairman of the Council of Botanical Collections and Supervisor of the Biological Laboratory and Botanic Garden in Cuba, and of the Arnold Arboretum, 1927–1935; Supervisor of the Botanical Museum, 1927–1937; Arnold Professor of Botany, 1932–1935; Research Professor of Botany, 1935–1941; Director of the Botanical Museum, 1937–1945; Research Professor of Botany, *Emeritus*, 1941; Associate Director of the Botanical Museum, 1945–1950.

In his administration of the various botanical agencies, Professor Ames showed an unusual capacity in the coordination of botanical interests and an appreciation of all phases of botany. His absolute integrity and sense of justice insured fair treatment of all botanical interests. There was never any question about the fulfillment of the moral and financial commitments of any agency under his administration. As a result the institutions under his guidance developed in material resources and scientific prestige. This

progress was accompanied by a greater unification of botanical interests and cooperation between all botanical agencies. In all of Professor Ames' administrative career he never overlooked the value of human relationships and the welfare of his staff members.

As Supervisor of the Arnold Arboretum, Professor Ames initiated a program which broadened the research activities of and effected a closer coordination with the botanical work in Cambridge. Little work was being done on the diseases of ornamental plants because the agricultural colleges and experiment stations had to give priority to plants of economic importance. A plant pathologist was added to the staff of the Arnold Arboretum who devoted his time to the diseases of trees and shrubs. Fewer exotic plants of ornamental value were being discovered in nature, and a plant breeder was added to the staff to produce new varieties of ornamental trees and shrubs by hybridization. A broader approach to the problems of plant classification and distribution was effected by adding to the staff a plant ecologist and an experimental taxonomist. These expanded activities strengthened the research work at the Arnold Arboretum. The teaching program at Harvard was also enriched by the services of Arboretum staff members who taught courses in taxonomy, cytology, ecology and plant pathology.

Professor Ames was a member of the American Association for the Advancement of Science, American Orchid Society, American Society of Naturalists, New York Academy of Sciences, National Institute of Social Sciences, New England Botanical Club, Massachusetts Horticultural Society, Boston Society of Natural History, Washington Academy of Sciences, Biological Society of Washington, Association International des Botanistes, Orchid Circle of Ceylon, Canal Zone Orchid Society, Torrey Botanical Club, American Fern Society and Sigma Xi. Among the honors conferred on Professor Ames were the following: a gold medal awarded by the American Orchid Society in 1924, the Centennial Medal of the Massachusetts Horticultural Society in 1929, the George Robert White Medal of Honor for eminent service in horticulture in 1935, election to the Linnean Society of London and to the American Academy of Arts and Sciences.

KARL SAX.

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1898

Concerning Acalypha hispida (Syn. A. Sanderi). Am. Gard. **19**: 827.

A new Species of Catasetum with Remarks about the Genus. Am. Gard. **19**: 741–742.

1899

Cattleya Trianae var. Summitensis. Am. Gard. **20**: 127.

An easy Method of Propagating Drosera filiformis. Rhodora **1**: 172 & *pl.*

* From "Orchids in Retrospect," prepared by Charles Schweinfurth and Albert F. Hill.

An Editor's Liberty; Letter to the Editor of Am. Gard. Am. Gard. **20**: 656.

New and Noteworthy Orchids: Cypripedium × Bingleyense var. Longwoodense (C. Charlesworthi × C. × Harrisianum var. superbum). Am. Gard. **20**: 835.

New or Interesting Orchids: Laelio-Cattleya Santiago; Laelio-Cattleya Sallieri Maron; Cattleya labiata var. C. G. Roebling. Am. Gard. **20**: 700.

New or Notable Orchids: Cypripedium insigne var. Laura Kimball. Am. Gard. **20**: 767.

New or Notable Orchids: Cypripedium × Kimballianum Grey. Am. Gard. **20**: 718–719.

New or Noteworthy Orchids: Laelio-cattleya Novelty N. E. Brown, var. Trentonensis Grey; Cypripedium insigne var. Mrs. G. B. Wilson. Am. Gard. **20**: 798.

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A New Plant: Selenipedium × Geralda (S. Lindleyanum Schomb. × S. caudatum Lindl.). Am. Gard. **20**: 654.

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Houlletia. L. H. Bailey Cyclop. Am. Hortic.: 775.
An interesting Group of new Hybrid Blooming Nymphaeas. Am. Gard. **21**: 644–645.
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1904

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A Contribution to our Knowledge of the Orchid Flora of southern Florida. Contrib. Ames Bot. Lab. No. **1:** 1–23 & *12 pl.*

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1913

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1914

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Notes on Mexican Species of Triphora. Orch. **7**: 39–44.

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A triandrous Form of Psilochilus macrophyllus. Orch. **7**: 45–48.

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1923

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Calanthe vestita Regnieri, Regnier's Calanthe. Addisonia **8**: 25–26.

New or noteworthy Orchids. Sched. Orch. **3**: 1–27.

New or noteworthy Orchids. Sched. Orch. **6**: 1–99.

New or noteworthy Orchids from Central America and the Philippine Islands. Sched. Orch. **5**: 1–42.

Orchidaceae quaedam Americanae II. Sched. Orch. **2**: 1–38.

Sarcopodium Lyonii. Addisonia **8**: 17–18.

1924

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1930

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1931

An Addition to the Flora of Honduras. Proc. Biol. Soc. Wash. **44**: 43–44.

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Juniperus virginiana growing on a Rock. Bull. Pop. Inform. Arnold Arb. Ser. 3, **5**: 62–64.

New or noteworthy Philippine Orchids I (with E. Quisumbing). Phil. Journ. Sci. **44**: 369–383 & *16 pl.*

A new species of Pleurothallis from Central America. Proc. Biol. Soc. Wash. **44**: 41–42.

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A new Bletia from Honduras. Proc. Biol. Soc. Wash. **45**: 1–2.

A new Epidendrum from Spanish Honduras. Bot. Mus. Leafl. Harvard Univ. **1**(2): 1–3.

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A new Variety of Laelia Digbyana. Am. Orch. Soc. Bull. **1**: 58–59.

Two new Orchids from Yucatan and Trinidad (with C. Schweinfurth). Bot. Mus. Leafl. Harvard Univ. **1**(2): 4–7.

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An Addition to the Genus Hexadesmia. Bot. Mus. Leafl. Harvard Univ. **1**(6): 1–2 & *pl.*

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A new Bletia from Spanish Honduras. Bot. Mus. Leafl. Harvard Univ. **1**(6): 5–6 & *pl.*

A new Epidendrum from Honduras. Bot. Mus. Leafl. Harvard Univ. **1**(8): 1–2 & *pl.*

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New or noteworthy Philippine Orchids IV (with E. Quisumbing). Phil. Journ. Sci. **52**:443–473 & *17 pl.*

A new Sobralia from the Republic of Honduras. Bot. Mus. Leafl. Harvard Univ. **1**(10): 1–5.

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1934

An Addition to the Genus Vanilla. Bot. Mus. Leafl. Harvard Univ. **2**: 101–102 & *pl.*

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A new Liparis from Guatemala (with C. Schweinfurth). Bot. Mus. Leafl. Harvard Univ. **2**: 97–98 & *pl.*

A new Pleurothallis from Honduras. Bot. Mus. Leafl. Harvard Univ. **2**: 25–28 & *pl.*

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Notes on Philippine Orchids. Bot. Mus. Leafl. Harvard Univ. **2**: 31–32.

Notes on Philippine Orchids II. Bot. Mus. Leafl. Harvard Univ. **2**: 39–40.

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Studies in Stelis I. Bot. Mus. Leafl. Harvard Univ. **2**: 1–24.

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A new Pleurothallis from Honduras. Bot. Mus. Leafl. Harvard Univ. **4**: 31–35.

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A rare Sobralia from Costa Rica. Bot. Mus. Leafl. Harvard Univ. **4**: 47–51.

A rare Vanilla. Bot. Mus. Leafl. Harvard Univ. **4**: 26–28 & *pl.*

Studies in Ponthieva (with C. Schweinfurth). Bot. Mus. Leafl. Harvard Univ. **4**: 38–40.

Studies in Stelis VI. Bot. Mus. Leafl. Harvard Univ. **4**: 21–25.

Two new Species of Epidendrum from Middle America (with F. Tracy Hubbard and C. Schweinfurth). Bot. Mus. Leafl. Harvard Univ. **4**: 1–7.

1937

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Pollination of Orchids through Pseudocopulation. Bot. Mus. Leafl. Harvard Univ. **5**: 1–29.

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Zeuxine strateumatica in Florida. Orchidol. Zeylan. **4**: 89–90.

1938

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Hintonella, a new Genus of the Ornithocephaleae from Mexico. Bot. Mus. Leafl. Harvard Univ. **6**: 185–191.

A new Campylocentrum from the Dominican Republic. Bot. Mus. Leafl. Harvard Univ. **6**: 23–27.

A new Telipogon from Costa Rica. Bot. Mus. Leafl. Harvard Univ. **6**: 28–33.

Nomenclatorial Changes. Bot. Mus. Leafl. Harvard Univ. **5**: 100–101.

Outline of Economic Botany (Biology 16 — Harvard University); Laboratory Guide (with P. A. Vestal). Bot. Mus., Cambridge, Mass. 19 pp.

Resupination as a diagnostic Character in the Orchidaceae with special Reference to Malaxis monophyllos. Bot. Mus. Leafl. Harvard Univ. **6**: 145–183.

Studies in Stelis VII. Bot. Mus. Leafl. Harvard Univ. **6**: 13–22.

Zeuxine strateumatica in Florida. Bot. Mus. Leafl. Harvard Univ. **6**: 37–45.

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A new Species of Pseudacoridium. Am. Orch. Soc. Bull. **9**: 44–45.

1941

The "Kashmir Orchid." Am. Orch. Soc. Bull. **10**: 188–189.

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Two Mexican Habenarias (with L. O. Williams). Bot. Mus. Leafl. Harvard Univ. **10**: 59–60.

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Orchids in Retrospect. Am. Orch. Soc. Bull. **11**: 102–106.

The Origin of the Term Orchis. Am. Orch. Soc. Bull. **11**: 146–147.

Some new or noteworthy Guatemalan Orchids (with D. S. Correll). Bot. Mus. Leafl. Harvard Univ. **10**: 61–92 & *10 pl.*

1943

A new Cattleya from Guatemala (with D. S. Correll). Am. Orch. Soc. Bull. **11**: 400–402.

A new Epidendrum from Guatemala (with D. S. Correll). Am. Orch. Soc. Bull. **12**: 60–61.

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Studies in Habenaria and Dichaea (with D. S. Correll). Bot. Mus. Leafl. Harvard Univ. **11**: 57–80.

1944

An Asiatic Orchid found wild in Florida. Am. Orch. Soc. Bull. **13**: 152–155.

Destruction of the Schlechter Herbarium by Bombing. Am. Orch. Soc. Bull. **13**: 105–106.

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1945

Notes on the Orchid Flora of the Philippines. Am. Orch. Soc. Bull. **13**: 320–326.

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1946

The Evolution of the Orchid Flower. Am. Orch. Soc. Bull. **14:** 355–360.
Notes on Resupination in the Orchidaceae. Am. Orch. Soc. Bull. **15:** 18–19.
The Rediscovery of a Lost Orchid. Boston. 16 pp.
The Ware Collection of Blaschka Glass Models of Plants in the Botanical Museum of Harvard University. Bot. Mus., Cambridge, Mass. 10 pp.

1947

Color Changes in Epidendrum tampense. Am. Orch. Soc. Bull. **16:** 442–443.
Commentaries on Spiranthes I. 1. Spiranthes tuberosa sensu Fernald. 2. Spiranthes gracilis var. floridana. Bot. Mus. Leafl. Harvard Univ. **13:** 17–31 & *pl.*
Drawings of Florida Orchids (with Blanche Ames). Ormond, Fla. (Printed at Cambridge, Mass.). 190 pp.
The Identity of Dendrobium "Guadalcanal." Am. Orch. Soc. Bull. **16:** 643–646.
Resupination and Pseudoresupination in Trichopilia suavis. Am. Orch. Soc. Bull. **16:** 370–372.

NOTES ON SOME MYRTACEAE OF FIJI

LILY M. PERRY

OF THE GENERA of the Myrtaceae which occur in the Fiji Islands, the genus *Syzygium* Gaertner is by far the largest. In it twenty-seven species had already been reported in various publications when Dr. A. C. Smith's excellent collection of some sixty Myrtaceae and twenty other miscellaneous collections came to hand for determination. These contained one species of *Cleistocalyx,* the usual forms of *Metrosideros* (and two collections which have fascicled inflorescences or inflorescences branched very close to the base; however, the flower-buds are so young that I have not attempted to name these beyond the genus), *Decaspermum, Psidium guajava,* and the New Caledonian genus *Piliocalyx* which, as far as I know, is here reported outside of New Caledonia for the first time. Of course the bulk of the collections belong to *Syzygium.* With so much material to be named, the time seemed opportune for presenting a summary of the species of *Syzygium.* Of all the species of this genus which I have studied, those of the Fiji Islands have been the most difficult to define. When one considers the variations which occur, it seems as though the species must be in a state of flux. There is a wide range in the size of the leaves, the length of the petiole, and sometimes in the shape of the leaf-base. There has been a tendency to use the subcordate leaf-base as a distinguishing character as opposed to the rounded leaf-base, and I must confess that in some cases it appears like a good character, but, with a large series of specimens at hand, both have occasionally been found on the same specimen. Another character which has been considered reliable is the shape of the branchlets, but here again one may find angled and compressed branchlets in the same collection. As always it is difficult to be sure that flowers and fruiting material have been matched correctly unless belonging to the same collection. All too often supplementary descriptive field notes are lacking.

In this study I have had the privilege of examining material from the following herbaria: Gray Herbarium (G), U. S. National Museum (US), the Bernice P. Bishop Museum (Bish), the New York Botanical Garden (NY), the University of California (Cal — type-collection), and the Arnold Arboretum (A).

KEY TO THE SPECIES OF SYZYGIUM

Bracts of the inflorescence persistent.
- Leaves sessile . . . . *S. Wolfii.*
- Leaves petiolate.
  - Flowers with calyx 4–7 mm. long, at the apex 4–6 mm. broad.
    - Disk lining the calyx-tube deeply cupulate . . . . *S. Brackenridgei.*
    - Disk lining the calyx-tube very shallow . . . . . . *S. oblongifolium.*

Flowers smaller, with calyx 3–4 mm. long, at the apex 2–2.5 mm. broad.....................................*S. confertiflorum.*

Bracts of the inflorescence caducous.

Flowers small; calyx (including pseudostalk) not more than 1 cm. long at anthesis.

Inflorescences usually found on the twigs below the leaves, or on the trunk, or on the slender branches growing from the trunk or the old growth.

Persistent calyx-limb crowning the fruit 3–5 mm. diameter; cotyledons lying side by side, the inner faces folded, the long radicle (extending to the outer margin of the cotyledons) lying within the folds.

Fruit elongate, fusiform (i.e., tapering at both base and apex); flower-buds subclavate........*S. corynocarpum.*

Fruit ellipsoid or obovoid-ellipsoid, rounded at the apex; flower-buds pyriform.....................*S. diffusum.*

Persistent calyx-limb crowning the fruit 2–3 mm. diameter; cotyledons superposed, the inner faces flat or concave, not folded, the radicle short; fruit oblong to oblong-ellipsoid.... ....*S. Cumini.*

Inflorescences axillary and terminal.

Calyx about 1 cm. long, 5–7 mm. broad at the apex; flowers crowded at the apices of the branchlets of the inflorescence (i.e., inflorescence compact).

Branchlets terete; leaves somewhat abruptly long-acuminate, veins more easily seen on the lower surface...... ....*S. nidie.*

Branchlets 4-angled; leaves shortly and obtusely acuminate, veins more easily seen on the upper surface.......... ....*S. leucanthum.*

Calyx 3–8 mm. long, usually around 3 mm. broad at the apex, or, if as broad as in the above species, the flowers not crowded at the apices of the branches of the inflorescence (i.e., inflorescence open).

Leaves rounded, or subcordate, or cordate at base.

Leaves rounded or subcordate at base, subsessile or short (to 1.2 cm. long) petiolate, secondary veins easily seen on the lower surface; inflorescence fairly large (7–15 cm. long), and many-flowered........ ....*S. Grayi.*

Leaves cordate at base, sessile, secondary veins obscure on the lower surface; inflorescence small (2–2.5 cm. long), and few-flowered...........*S. simillimum.*

Leaves cuneate at base, or, if rounded, narrowed into the petiole.

Calyx pyriform; leaves with two intramarginal veins, the outer one finer than the inner..*S. phaeophyllum.*

Calyx turbinate; leaves with usually only one intramarginal vein.

Calyx gradually narrowed below the limb, near the base contracted into a short pseudostalk.

Calyx definitely lobed, the lobes 2–3 mm. wide, 1–1.5 mm. high; leaves obviously closely veined and acuminate......*S. curvistylum.*

Calyx repandly lobed; leaves obscurely veined, obovate or elliptic, rounded, or obtuse, or retuse, but sometimes acutish at the apex........................*S. effusum.*

Calyx somewhat abruptly narrowed below the limb (i.e., above or near the middle), the tapering base with pseudostalk longer than, or almost as long as the upper part.

Branchlets sharply 4-angled. Small tree apparently common on the banks of streams.. ....*S. Seemannianum.*

Branchlets terete. Trees of the forest and open rolling country.

Secondary nerves and reticulations easily seen with the naked eye on the upper surface of the leaves, less prominent on the lower surface; calyx-tube abruptly contracted into a pseudostalk only a little shorter than the narrowly campanulate upper part........*S. fijiense.*

Secondary nerves and reticulations obscure on the upper surface of the leaves, usually manifest or inconspicuous on the lower surface; calyx-tube somewhat abruptly contracted into a pseudostalk longer than the narrowly campanulate upper part.

Inflorescence usually longer than the subtending leaves, with widely spreading branches, profusely flowering; leaves acuminate, secondary venation usually inconspicuous...........*S. rubescens.*

Inflorescence usually not longer than the subtending leaves and smaller than in *S. rubescens;* leaves subacuminate or obtusely acuminate, secondary venation easily seen... ....*S. amicorum.*

Flowers large; calyx (including pseudostalk) at least 1.3 cm. long and 1 cm. broad (at apex) at anthesis.

Inflorescence on branches below the leaves.

Leaves cuneate at base.......................*S. malaccense.*

Leaves rounded or subcordate at base...............*S. Richii.*

Inflorescence axillary and/or terminal.

Inflorescence on a very short axis; flowers sessile in heads or sometimes solitary.

Calyx-tube ribbed; leaves comparatively narrow (to 8.5 cm.)...............................*S. neurocalyx.*

Calyx-tube not ribbed; leaves very broad (to 17 cm.) . . . . *S. amplifolium.*

Inflorescence with an obvious axis and branches.

Inflorescence dense; axis with very short branches . . . . *S. quadrangulatum.*

Inflorescence open.

Base of the leaves rounded or subcordate or cordate.

Inflorescence axis and branchlets somewhat robust; flowers numerous (15–50).

Flowers pyriform, with practically no pseudostalk . . . . *S. Richii.*

Flowers infundibular, tapering to a very slender base or pseudostalk . . *S. nandarivatense.*

Inflorescence axis and branchlets (if present) slender; flowers 1–3(–7) . . . . *S. gracilipes.*

Base of the leaves cuneate (or if rounded then shortly cuneate or shortly decurrent on the petiole).

Leaves long acuminate; petioles not more than 1.5 cm. long . . . . *S. Jambos.*

Leaves blunt or acute, not acuminate; petioles usually more than 1.5 cm. long.

Fruit obovoid; petioles 3.5 cm. long . . . . *S. Gillespiei.*

Fruit globose; petioles 1–2.5 cm. . . . . *S. tetrapleurum.*

Syzygium Wolfii (Gillespie) Merrill & Perry in Sargentia 1: 75. 1942.

Eugenia Wolfii Gillespie in Bishop Mus. Bull. **83**: *22, fig. 28.* 1931.— A. C. Smith in Bishop Mus. Bull. **141**: 106. 1938.

VANUA LEVU: Mathuata, Wainunu-Ndreketi Divide, in dense forest, alt. 200–300 m., *A. C. Smith 1854* (G), May 1934 (slender tree 20 m. high); Seangganggа Plateau, in drainage of Korovuli River, vicinity of Natua, patches of forest in open rolling country, alt. 100–200 m., *A. C. Smith 6877* (A), Nov.-Dec. 1947 (tree 10 m. high, locally frequent but rarely fertile; young fruit pink to deep purple). FIJI: without further locality, *J. Horne 1100* (G).

I have been unable to locate the type of this species, but from the specimens cited above, it would appear that the species is readily distinguished by the large sessile or subsessile leaves.

Syzygium Brackenridgei (A. Gray) C. Mueller in Walpers Ann. 4: 838. 1857.— Merrill & Perry in Sargentia 1: 75. 1942.

Eugenia Brackenridgei A. Gray, Bot. U. S. Expl. Exped. **1**: 521. 1854; Atlas *pl. 61 A.* 1857.

Jambosa Brackenridgei Brongn. & Gris in Bull. Soc. Bot. Fr. **12**: 181. 1865.

Pareugenia Imthurnii Turrill in Jour. Linn. Soc. Bot. **43**: 21. 1915; in Hook. Icon. **31**: *pl. 3004.* 1915.

Pareugenia Brackenridgei (A. Gray) A. C. Smith in Bishop Mus. Bull. **141**: 109. 1936.

Syzygium Imthurnii (Turrill) Merrill & Perry in Sargentia **1**: 75. 1942.

VANUA LEVU: Mathuata: Seanggangga Plateau, in drainage of Korovuli River, vicinity of Natua, patches of forest in open rolling country, alt. 100–200 m., *A. C. Smith 6738* (A), Nov.-Dec. 1947 (tree 7 m. high; old calyces pink-tinged, at length rich purple).
OVALAU: without further locality, *U. S. Expl. Exped. 1838–1842* (type-collection, G).
VITI LEVU: Lautoka: mountains near Lautoka, *W. Greenwood 36* (A), Aug. 1920. Nandronga & Navosa: northern portion of Rairaimatuku Plateau, between Nandrau and Rewasau, dense forest, alt. 725–825 m., *A. C. Smith 5443* (A). Tholo North: Nandarivatu, valley of the Singatoka, alt. 850 m., *J. W. Gillespie 3834* (Bish), Nov. 1927; Nandarivatu, 2 miles up the Mba trail, alt. 1000 m., *J. W. Gillespie 4042* (Bish), Nov. 1927; vicinity of Nandarivatu, alt. 900 m., *J. W. Gillespie 4193* (Bish), Dec. 1927; Nandarivatu, margin of thick bush on ridge, alt. 1300 m., *H. E. Parks 20682* (Bish), July 1927. Namosi: trail up Voma Mountain from Namosi, alt. 600 m., *J. W. Gillespie 2904* (Bish), Sept. 1927; trail between Nangarawai and Sele ni ndrau villages, *J. W. Gillespie 3225* (Bish), Sept. 1927; vicinity of Namosi, near stream, alt. 400 m., *J. W. Gillespie 2657* (Bish), Sept. 1927; Namosi, *B. Seemann 155* (G).
KANDAVU: Mt. Mbuke Levu, alt. 200–500 m., *A. C. Smith 239* (G), Oct. 1933.

This species shows considerable variation in the size of the leaves. In *Gillespie 3834* only the upper leaves are shown, the largest of these being 6.5 × 3.5 cm. In the type-collection of *S. Brackenridgei* (A. Gray) C. Mueller the small leaves (11 × 4 cm.) are narrowly cuneate at base, but the one large leaf (21 × 10 cm.) in the Gray Herbarium specimen is broadly cuneate or acute at the base. Most of the other collections have leaves intermediate in size between the extremes given above. I have not seen the type-specimen of *S. Imthurnii* (*Pareugenia Imthurnii* Turrill), but I have at hand four collections (*Gillespie 3834, 4042, 4193,* and *Parks 20682*) gathered in the vicinity of Nandarivatu, the type-locality of Turrill's species. According to the size of the leaves given in the description these specimens would belong to *S. Imthurnii*. However, other specimens show a complete transition to typical *S. Brackenridgei*, and at present I can see no character sufficient to distinguish two species.

Syzygium Brackenridgei (A. Gray) C. Mueller var. **dubium**, var. nov.

A forma typica differt foliis oblongis utrinque angustatis; inflorescentiis similibus.

VANUA LEVU: Mathuata: Lower Wainunu River Valley, thin forest, alt. 0–200 m., *A. C. Smith 1723* (A), May 1934 (tree 8 m. high; calyx and petals pink to red; filaments rich pink; anthers yellow); summit ridge of Mt. Numbuiloa, east of Lambasa, dense forest, alt. 500–590 m., *A. C. Smith 6524* (Arnold Arboretum, TYPE of var.), Oct.-Nov. 1947 (tree 4 m. high; calyces pink to purple).

These two specimens have oblong leaves; apart from that I do not at present observe any other variation from the species unless it might be that the flowers are slightly larger. In our representation of *S. Brackenridgei* (A. Gray) C. Muell. not too many mature flowers are present.

Syzygium oblongifolium (Gillespie) Merrill & Perry in Sargentia 1: 75. 1942.

Pareugenia oblongifolia Gillespie in Bishop Mus. Bull. **83**: 23, *fig. 29*. 1931.

VITI LEVU: Namosi: near summit of Vakarongasiu Mt., alt. 850 m., *J. W. Gillespie 3268* (type-collection, Cal), Oct. 1927. Naitasiri: Waidanda, *B. E. Parham 782* (A). Mba: hills between Nggaliwana and Tumbeindreketi Creeks, east of sawmill at Navai, alt. 725–800 m., *A. C. Smith 5897* (A), Sept. 1947 (tree 10 m. high; petals and filaments greenish white, becoming pure white; anthers pale yellow; disk and style white). Nandronga & Navosa: northern portion of Rairaimatuku Plateau, between Nandrau and Rewasau, in dense forest, alt. 725–825 m., *A. C. Smith 5420* (A), Aug. 1947. FIJI: without further locality, *J. Horne 936* (G).

Syzygium oblongifolium and *S. Brackenridgei* closely resemble each other. In the former, the limb of the calyx is very short, so that the disk lining it is only slightly concave; the leaves are usually oblong-elliptic or elliptic with a short-acuminate apex. In the latter, the limb of the calyx is longer, consequently the disk is deeply cup-shaped; the leaves are usually oblanceolate or obovate-elliptic, but occasionally elliptic, and at the apex rounded or slightly retuse, or sometimes short-acuminate. In most of the leaves with round or retuse apex the growing tip appears to have been stunted.

Syzygium confertiflorum (A. Gray) C. Mueller in Walpers Ann. 4: 838. 1857.

Eugenia confertiflora A. Gray, Bot. U. S. Expl. Exped. **1**: 523. 1854; Atlas *pl. 64B*. 1857. — A. C. Smith in Bishop Mus. Bull. **141**: 105. 1936.

VANUA LEVU: Yanawai River region, Mount Kasi, dense bush, alt. 300–430 m., *A. C. Smith 1757* (G), *1797* (G). FIJI: without further locality, *J. Horne 702* (G), *1056* (G).

OVALAU: *U. S. Expl. Exped. 1838–1842* (type-collection, G).

Syzygium corynocarpum (A. Gray) C. Mueller in Walpers Ann. 4: 839. 1857. — E. Christophersen in Bishop Mus. Bull. **154**: 23. 1938.

Eugenia corynocarpa A. Gray, U. S. Expl. Exped. **1**: 536. 1854; Atlas *t. 64*. 1857.

VANUA LEVU: Mathuata: Mathuata Coast, *W. Greenwood 649* (A) (small tree 15 ft. high, with spreading branches; young buds often purplish; flowers white, strong-scented; petals pushed off in one piece; flowers often borne on short branches on old wood near centre of tree). Thakaundrove: Maravu, near Salt Lake, in very dark woods, *O. Degener & E. Ordonez 14219* (A), Jan. 1941 (tree to 3 m. high; fruit dark red or pure yellow, partly cauliflorous, sometimes produced so low on the trunk as to lie on the ground); near Urata, Savu Savu Bay region, in forest near the shore, *O. Degener & E. Ordonez 13927* (A), Dec.-Jan. 1941. FIJI: without further locality, *U. S. Expl. Exped. 1838–1842* (G, type-collection), *B. Seemann 153* (G), *B. E. Parham 1045* (A).

VITI LEVU: Tholo North: Mt. Matomba, Nandala, vicinity of Nandarivatu, in rich dark forest, alt. 750–900 m., *O. Degener 14453* (A), Feb. 1941 (tree 4–5 m. high; fruits very dark red); Nauwanga, near Nan-

darivatu, alt. 750–900 m., *O. Degener 14676* (A), Feb.-Mar. 1941 (tree 3 m. high; fruit dark red). Namosi: hills between Navua River and Suva, alt. 200–300 m., *W. Greenwood 1017* (A), May 1943 (weak tree about 15 ft. high, with leaves only at the ends of the twigs; inflorescence on the main stem 3–4 ft. from the ground — on another tree an inflorescence was 6 inches from the ground). Rewa: Korobamba, *A. Meebold 16691* (Bish), July 1932; southeast slope of Korobamba Mountain, alt. 200 and 300 m., *J. W. Gillespie 2239* (Bish), *2441* (Bish), Aug. 1927.

Christophersen (Bishop Mus. Bull. 154: 23. 1938) noted that this species is characterized by the elongated beaked fruits and the distinctly bicolored leaves. It should also be pointed out that the flowers are sessile or subsessile, and the space occupied by the locules of the ovary is much longer than broad, whereas in the other species this space is as broad as long. *Rechinger 1856* (US), and *Vaupel 257* (US), from Samoa belong to this species. Rechinger's collection was published as *E. amicorum* A. Gray.

Syzygium diffusum (Turrill) Merrill & Perry in Sargentia 1: 76. 1942.

Eugenia diffusa Turrill in Jour. Linn. Soc. Bot. **43**: 20. 1915. — A. C. Smith in Bishop Mus. Bull. **141**: 107. 1936.

Syzygium aneityense Guillaumin in Jour. Arnold Arb. **12**: 256. 1931.

TAVEUNI: western slope, between Somosomo and Wairiki, alt. 500–900 m., *A. C. Smith 755* (G), *769* (G), *797* (G).

KORO: eastern slope of main ridge, *A. C. Smith 994* (G).

VITI LEVU: Lautoka: Mt. Evans, near summit, alt. 1200 m., *W. Greenwood 948* (A), Oct. 1942 (tree about 20 ft. high; fruit in big bunches on the stem about 1–2 ft. below the terminal leaves; fruit at first red but deep purple when ripe, about 1.5 cm. diameter and 2 cm. long, orifice 3 mm. wide); Mt. Evans, alt. 1090 m., *W. Greenwood 965* (A), Dec. 1942 (tree 15–20 ft. high; inflorescences on short branches with leaves behind the ends of shoots, or on the main trunk without any leaves). Nandronga & Navosa: northern portion of Rairaimatuku Plateau, between Nandrau and Rewasau, dense forest, alt. 725–825 m., *A. C. Smith 5612* (A), July-Aug. 1947 (tree 12 m. high; inflorescence from the trunk; calyx dull green, pink-tinged distally; young petals pinkish on exposed areas, otherwise with filaments and style pale yellow); southern slopes of Nausori Highlands, in drainage of Namosi Creek above Tumbenasolo, dense forest, alt. 300–450 m., *A. C. Smith 4714* (A), May-June 1947. Naitasiri: Viria, in rain forests, alt. 400 m., *H. E. Parks 20434* (Bish).

KANDAVU: Mt. Mbuke Levu, alt. 200–500 m., *A. C. Smith 224* (G).
FIJI: without further locality, *J. Horne 443* (G).

I am indebted to Dr. H. Emery Moore, Jr. of Ithaca, N. Y., for a photograph of the type (two sheets) of this species in the Kew Herbarium. I believe our material to be a good match for it. In general our specimens are more profusely flowering and the leaves are 8–13 cm. long, 2.5–5 cm. broad, but these are variations to be expected.

Syzygium diffusum (Turrill) Merrill & Perry var. **purpureum** var. nov.

A forma typica differt foliis usque 7 cm. longis, 3 cm. latis, plerumque 6 × 2.5 cm.

VANUA LEVU: Mathuata: summit ridge of Mt. Numbuiloa, east of Lambasa, dense forest, alt. 500–590 m., *A. C. Smith 6413* (Arnold Arboretum, TYPE of var.), Oct.-Nov. 1947 (slender tree 6–10 m. high; inflorescence arising from trunk or sometimes on leafy branches; inflorescence-branches and young flowers [buds] rich purple; filaments and style white); Seanggangga Plateau, in drainage of Korovuli River, vicinity of Natua, patches of forest in open rolling country, alt. 100–200 m., *A. C. Smith 6681* (A), Nov.-Dec. 1947 (tree 15 m. high; inflorescence branches and flowers [buds] rich purple).

VITI LEVU: Korubalevu, dense jungle, alt. 450 m., *H. E. Parks 20318* (Bish), June 1927. Rewa: southeast slopes of Korobamba Mountain, alt. 300 m., *J. W. Gillespie 2219* (Bish), Aug. 1927; near summit of Korobamba Mountain, alt. 500 m., *J. W. Gillespie 2313* (Bish), Aug. 1927. Tholo North: Nandarivatu, thick forests, alt. 1400 m., *H. E. Parks 20778* in part (Bish), July 1927. Mba: northern portion of Mt. Evans Range, between Vatuyanitu and Mt. Natondra, dense forest, alt. 700–900 m., *A. C. Smith 4351* (A), May 1947 (tree 15 m. high; fruit dependent from slender branches; fructescence freely branched, about 1 m. long).

These collections seem to differ from *S. diffusum* only in the smaller leaves, those in the species usually being around 10 cm. long and 4–5 cm. broad. None of the specimens cited have either flowers at anthesis or mature fruits.

Syzygium Cumini (L.) Skeels in U. S. Dept. Agric. Bur. Pl. Ind. Bull. 248: 25. 1912. — Alston, Handb. Fl. Ceylon 6(Suppl.): 116. 1931. — Merrill & Perry in Jour. Arnold Arb. **19**: 108, 230. 1938.

Myrtus Cumini Linn. Sp. Pl. 471. 1753.

Eugenia Jambolana Lam. Encycl. **3**: 198. 1789.

Eugenia Cumini Druce in Rept. Bot. Exch. Club Brit. Isles **3**: 418. 1914. — M. R. Henderson in Gardens Bull. Singapore **12**: 182, *fig. 35*. 1949.

FIJI: without further locality, *M. Scott 1060* (A), March 1938 (tree 15–20 ft. high).

Probably introduced for cultivation. So far as I know the species has not been reported previously from Fiji.

Syzygium nidie Guillaumin in Jour. Arnold Arb. **12**: 257. 1931. — Merrill & Perry in Sargentia **1**: 77. 1942.

Type-collection from Aneityum. Previously reported from Fiji on the basis of *Degener 14550* (A), *14665* (A).

Syzygium leucanthum, sp. nov.

Arbor 10 m. alta glabra; ramulis quadrangularibus; foliis in sicco tenuiter coriaceis ellipticis vel interdum subrhombicis, olivaceis subtus pallidioribus et glandulosis (glandulis minutis parce adspersis), 2.5–6 cm. longis, 1–2.8 cm. latis, apice abrupte et breviter acuminatis (acumine 3–5 mm. longo, 2–4 mm. lato obtuso), basi obtusis deinde fere ad basim petioli decurrentibus, costa utrinque brunnescente, nervis primariis numerosis tenuibus fere transversis supra paululo elevatis subtus manifestis, vena intramarginali a margine recurvo 0.5 mm. remota conjunctis, rete venu-

larum subobscuro; petiolo (cum basi decurrente folii) 5–9 mm. longo (sine basi decurrente 3 mm. longo) planiusculo; inflorescentiis terminalibus, trichotomis usque 4 cm. longis, axi et ramulis quadrangularibus; floribus sessilibus vel subsessilibus 3 in apice ramulorum dispositis; bracteis ovatis, 4 mm. longis, caducis; alabastris 1–1.2 cm. longis; calyce sub anthesin obconico vel subturbinato, 9 mm. longo, apice 7 mm. lato, lobis 4 circiter 3 mm. latis et 1.3 mm. longis, probabiliter persistentibus; petalis calyptratim caducis; staminibus numerosis, filamentis ca. 8 mm. longis, antheris ellipticis ca. 0.4 mm. longis; stylo 6–7 mm. longo; fructibus non visis.

VITI LEVU: Naitasiri: northern portion of Rairaimatuku Plateau between Mt. Tomanivi and Nasonggo, dense forest, alt. 870–970 m., *A. C. Smith 6088* (Arnold Arboretum, TYPE), Aug.-Sept. 1947 (tree 10 m. high, with bushy crown; calyx green, pink-tinged; petals white, faintly pink-tinged, soon caducous; filaments pure white, anthers pale yellow).

This species is most like *S. nidie* (Guillaumin) Merrill & Perry. The latter, however, has leaves which are chartaceous, becoming brittle when dry, the veins are more easily seen on the lower surface, the acumen is long and narrow, the base is only very shortly decurrent on a rugose petiole (channeled on the upper side), and the branchlets are terete. In *S. leucanthum* the leaves are somewhat leathery in texture, the veins are more obvious on the upper surface, the acumen is short and broad, the base is relatively long-decurrent so that the petiole appears very short, and the branchlets are quadrangular. In this species too the flowers taper a little more toward the base, i.e., tend to be turbinate, and are perhaps a little more crowded at the apices of the branchlets.

Syzygium Grayi (Seemann) Merrill & Perry in Sargentia 1: 76. 1942.

Eugenia Grayi Seeman, Fl. Vit. 79, *pl. 16*. 1865.

VANUA LEVU: Thakaundrove: Maravu, near Salt Lake, in forest, alt. 0–450 m., *O. Degener & E. Ordonez 14161* (A), Jan. 1941 (tree 8 m. high; petals whitish); Savu Savu Bay region, between Mbalanga and Valethi, in open forest, alt. 0–400 m., *O. Degener & E. Ordonez 14039* (A), Dec.-Jan. 1941 (tree 5 m. high; flowers white).

VITI LEVU: Nandronga & Navosa: southern slopes of Nausori Highlands, in drainage of Namosi Creek above Tumbenasolo, dense forest, alt. 300–450 m., *A. C. Smith 4597* (A), May-June 1947 (tree 15 m. high; inflorescence sometimes associated with foliage, sometimes pendent on long leafless branchlets; young petals pink-tinged; filaments pure white); northern portion of Rairaimatuku Plateau, between Nandrau and Rewasau, dense forest, alt. 725–825 m., *A. C. Smith 5643* (A), July-Aug. 1947 (tree 8 m. high; calyx yellow, pink-tinged distally; filaments and style pale yellow). Namosi: trail from Namosi up Voma Mountain, alt. 450 m., *J. W. Gillespie 2516* (Bish); bank of stream above waterfall near Namuamua, alt. 400 m., *J. W. Gillespie 2985* (Bish). Naitasiri: Waindina River, Nawangambena, *F. Raiqiso 746* (A); Viria, *A. Meebold 16888* (Bish). Tholo North: Natuku, Navai, alt. 750–900 m., *O. Degener 15028* (A), Feb.-Mar. 1941 (tree 3 m. high); Mataivisai, Navai, *O. Degener 15029a* (A), Feb.-Mar. 1941 (tree 3 m. high). Mba: hills between Nggaliwana and Tum-

beindreketi Creeks, east of sawmill at Navai, dense forest, alt. 725–800 m., *A. C. Smith 5871* (A), Sept. 1947 (tree 8 m. high; inflorescence on branchlets below leaves; young bracts and flower-buds greenish yellow). Lautoka: mountains near Lautoka, alt. about 360 m., *W. Greenwood 906* (A), Oct. 1941 (upright tree 6 m. high).

KANDAVU: without further locality, *B. Seemann 163* (G). FIJI: without further locality, *J. Horne 742, 758* (G).

The collections above cited are reasonably uniform with leaves 10–28 cm. long, 5–9 cm. broad. In addition to these there are at hand five specimens, *O. Degener 14455* (A), *14902* (A), *J. W. Gillespie 3218* (Bish), *3917* (Bish), and *W. Greenwood 881* (A), from the vicinity of Nandarivatu, Viti Levu, which have leaves only 5–12.5 cm. long and 3–5.5 cm. broad. The field labels do not indicate whether these trees have larger leaves or not. In spite of the difference in the size of the leaves, all appear to belong to the species. Then again there are two collections from Vanua Levu, *A. C. Smith 1803* (A), *6582* (A), which, although most like *S. Grayi*, differ each in a single obvious character. In the first the base of the leaves is not rounded or subcordate as is to be expected in this species, but cuneate with the lamina decurrent along the petiole; in the second the apex of the leaves differs in being obtuse rather than acute or acuminate.

Syzygium simillimum Merrill & Perry in Sargentia 1: 76. 1942.

Type-collection (*O. Degener & E. Ordonez 14093*) from Vanua Levu. I have seen no further material of this species.

Syzygium phaeophyllum Merrill & Perry in Jour. Arnold Arb. 26: 103. 1945.

Eugenia durifolia A. C. Smith in Bishop Mus. Bull. **141**: 105, *fig. 56.* 1936.
Syzygium durifolium Merrill & Perry in Sargentia **1**: 76. 1942, non in Mem. Acad. Arts & Sci. **18**: 176. 1939.

Type-collection (*A. C. Smith 919*) from the island of Taveuni. I have seen no other collections which match this. It seems best characterized by long-acuminate leaves with two intramarginal veins, the outer one (2 mm. within the margin) finer than the inner (4–5 mm. within the margin), flower-buds with calyx tapering evenly from the apex to the base, and pale brown branchlets.

Syzygium curvistylum (Gillespie) Merrill & Perry in Sargentia 1: 75. 1942.

Eugenia curvistyla Gillespie in Bishop Mus. Bull. **83**: 21, *fig. 26.* 1931.

VANUA LEVU: Mathuata: southern slopes of Mt. Numbuiloa, east of Lambasa, in open forest, alt. 100–350 m., *A. C. Smith 6394* (A), Oct.-Nov. 1947 (tree 25 m. high; trunk about 60 cm. diameter; calyx rich purple distally); Seanggangga Plateau, in drainage of Korovuli River, vicinity of Natua, patches of forest in open rolling country, alt. 100–200 m., *A. C. Smith 6900* (A), Nov.-Dec. 1947 (spreading tree 15 m. high; fruit deep red to deep purple).

VITI LEVU: without further locality, *B. Seemann 152* (G). Tholo North: trail near Vatu There, alt. 900 m., *J. W. Gillespie 4269* (Bish, type-collection), Nov. 1927.

This species is probably best characterized by the acuminate closely veined leaves and the persistent calyx lobes. Seemann's collection is a perfect match for the type-collection, although previous to receiving the loan of the co-type it had seemed to be an aberrant form of the species both in the shape of the leaves and the size of the flowers. The other specimens earlier designated as this species have been placed in that varying, puzzling, and collective species *S. amicorum* (A. Gray) C. Mueller.

Syzygium curvistylum (Gillespie) Merrill & Perry var. **parvifolium**, var. nov.

Foliis usque 6 cm. longis, 2.5 cm. latis, aliter formae typicae speciei simile.

VANUA LEVU: Mbua: southern portion of Seatovo Range, forest, common on ridges, alt. 100–350 m., *A. C. Smith 1556* (Arnold Arboretum, TYPE of var.).

VITI LEVU: Tholo North: vicinity of Nandarivatu, valley of the Singatoka, *J. W. Gillespie 3723* (Bish), Nov. 1927; Nandarivatu, summit ridge of Loma laga, alt. 1200 m., *J. W. Gillespie 3875* (Bish), Nov. 1927; vicinity of Nandarivatu, alt. 900 m., *J. W. Gillespie 4266* (Bish), Dec. 1927.

The relation between the collections cited above and *S. curvistylum* (Gillespie) Merrill & Perry became obvious in the working out of a key for the group. Although the leaves of the latter are larger, their shape and the pattern of the venation are similar in both instances. Likewise the flowers are about the same size, the calyx in both having apparently persistent lobes. The flowers of *Smith 1556* appear to be softer or less spongy in texture than those of the type of the species. Whether this is a difference owing to environmental conditions, or age, or a valid difference, I do not know. At present it seems best to consider the differences only varietal.

Syzygium effusum (A. Gray) C. Mueller in Walpers Ann. 4: 838. 1857. — E. Christophersen in Bishop Mus. Bull. 154: 23. 1938.

Eugenia effusa A. Gray, Bot. U. S. Expl. Exped. 1: 524. 1854.

VANUA LEVU: Thakaundrove: Yanawai River region, Mount Kasi, dense forest, alt. 300–430 m., *A. C. Smith 1821* (G), May 1934 (tree 12 m. high; fruit white). Bua: Bua Bay, *U. S. Expl. Exped. 1838–1842* (type-collection, G).

OVALAU: without further locality, *B. Seemann 151* (G).

VITI LEVU: Tholo West: vicinity of Mbelo, near Vatukarasa, alt. 120–300 m., *O. Degener 15271* (A), (*A. Tabualewa*) *15624* (A); Mbuyombuyo, near Namboutini, in forest, *O. Degener* (*A. Tabualewa*) *15595* (A).

MOALA: forest above Maloku, alt. 400 m., *A. C. Smith 1346* (A), May 1934 (tree 15 m. high; young fruit pink); wind-swept ridge, edge of bare area and rain forest, alt. near 350 m., *E. H. Bryan, Jr. 308* (A, Bish), July 1924 (small tree 4–5 m. high, up to 12 cm. diameter; bark gray-brown, moderately smooth; sapwood thin, red-brown; heartwood hard, yellow-brown; fruit white). FIJI: without further data, *Forest Dept. 122* (*Dept. Agriculture 1427*) (A); *J. Horne 431* (G).

This species has been confused with *S. confertiflorum* (A. Gray) C. Muell. The latter, however, has an inflorescence with apparently persistent bracts, and the glands of the leaves are more evenly distributed, although at a glance the leaves seem much alike. In *S. effusum* (A. Gray) C. Mueller the bracts of the inflorescence apparently fall long before the flowers bloom.

Syzygium Seemannianum Merrill & Perry in Sargentia 1: 76. 1942.

Eugenia rivularis Seemann Fl. Vit. 80. 1865; non Syzygium rivulare Vieill. ex Guillaumin in Bull. Soc. Bot. Fr. **85**: 645. 1938.

VITI LEVU: Navua River, *B. Seemann 162* (type-collection, G). Namosi: vicinity of Namosi, alt. 450 m., *J. W. Gillespie 2936* (Bish, NY); trail in vicinity of Nangarawai village, alt. 500 m., *J. W. Gillespie 3204* (Bish, US). Naitasiri: Waindina River, *B. E. Parham 903* (A); Waindina River Basin, alt. 50 m., *L. H. McDaniels 1032* (Bish). Tholo North: near Wainibuka River at Nasukamai, alt. 400 and 450 m., *J. W. Gillespie 3394.5* (Bish), *4691.3* (Bish); vicinity of Nandarivatu, along stream, alt. 750–900 m., *O. Degener 14272A* (A), *J. W. Gillespie 3394.5* (Bish), *3961* (Bish); Nandarivatu, 2 miles down the Nandrau trail, at stream, alt. 800 m., *J. W. Gillespie 4221* (Bish, NY). Mba (formerly Tholo North): valley of Nandala Creek, about 3 miles south of Nandarivatu, thickets along creek, alt. about 780 m., *A. C. Smith 6255* (A), Sept. 1947 (tree 2–4 m. high, the branches drooping on water and doubtless submerged in floods; petals pink-tinged; filaments white; calyx purplish). Ra: vicinity of Rewasa, near Vaileka, along stream, *O. Degener 15466* (A, NY), June 1941 (small to medium tree characteristic of stream banks).

KANDAVU: region of Namalata Isthmus, *A. C. Smith 28* (G, NY, US).

Syzygium fijiense, sp. nov.

Arbor 18–25 m. alta, glabra; ramulis teretibus vel apicem versus compressis, cortice pallide fusco; foliis chartaceis vel tenuiter coriaceis ellipticis, 4.5–9.5 cm. longis, 1.8–4.5 cm. latis, apice abrupte et longiuscule acuminatis (acumine 0.7–1.7 cm. longo et basi 5 mm. lato) basi obtusis deinde ad petiolum sensim angustatis, nervis primariis crebris et tenuibus paullo ascendentibus, vena intramarginali a margine 1–2 mm. remota conjunctis, nervis et rete venularum utrinque tenuiter elevatis praecipue supra distincte manifestis; petiolo 0.5–1.5 cm. longo gracile; paniculis terminalibus vel in ramulis brevibus lateralibus dispositis, 7–15 cm. longis latisque, ramulis late patentibus subteretibus; floribus in apice ramulorum 3 vel 2 vel 1 sessilibus vel brevissime pedicellatis; alabastro turbinato; calycis tubo in sicco basi 2 mm. stipitato deinde subabrupte 2 mm. campanulato-obconico, minute lobato; petalis calyptratim caducis; staminibus numerosis, filamentis vix 5 mm. longis, antheris 0.5 mm. latis, 0.3 mm. longis; stylo ca. 4.5 mm. longo; fructibus obovoideis, 1 cm. longis et 0.6 cm. diam., apice calycis tubo (vix 3 mm. lato) coronatis; cotyledonibus superpositis, radicula brevi.

VANUA LEVU: Mathuata: summit ridge of Mt. Numbuiloa, east of Lambasa, dense forest, alt. 500–590 m., *A. C. Smith 6464* (A), Oct.-Nov. 1947 (tree 18 m. high; trunk about 30 cm. diam.; petals and filaments white);

Seanggangga Plateau, in drainage of Korovuli River, vicinity of Natua: patches of forest in open rolling country, alt. 100–200 m., *A. C. Smith 6722* (Arnold Arboretum, TYPE), Nov.-Dec. 1947 (tree 25 m. high; calyx reddish-tinged; filaments white, anthers pale yellow).

OVALAU: without further locality, *B. Seemann 154* (G).

VITI LEVU: Tholo North: Nandarivatu, 2 miles down the Mba trail, alt. 950 m., *J. W. Gillespie 4043* (Bish, NY), Nov. 1927.

In addition to the above cited specimens there are at hand two sterile ones, *J. W. Gillespie 4813* and *J. Horne 1106*, which appear to be more like this species than any other; however, knowing the difficulty of determining sterile specimens in this genus with any degree of accuracy, I mention these with some hesitancy. In the past this species has been called *S. rubescens* (A. Gray) C. Mueller, and in the Gray Herbarium a fragment of Gray's type and *Seemann 154* (both from Ovalau) are mounted on the same sheet. Both dried approximately the same color, but the leaves of Seemann's collection are shorter and broader, and the reticulate venation (particularly on the upper surface) is obvious to the naked eye. In the other specimen the leaves have a smooth surface, the primary veins for the most part being obscure on the upper surface and at times inconspicuous below; the flowers also are a little longer and more clavate. Without further material these variations might well be regarded as intraspecific. Fortunately the new collection under study contains a specimen (*Smith 6722*) with both flowers and fruit, and the differences in the fruits of the two are at once apparent. In *S. fijiense* the fruits are oblong-obovoid, the seed has superposed cotyledons with concave inner faces and a very short radicle. In *S. rubescens*, on the other hand, the fruit is subglobose, the cotyledons lie side by side with the inner faces folding over a radicle long enough to reach to the margin of the cotyledons.

Syzygium rubescens (A. Gray) C. Mueller in Walpers Ann. **4**: 839. 1857.

Eugenia rubescens A. Gray, U. S. Expl. Exped. **1**: 525. 1854.

OVALAU: vicinity of Levuka, hills overlooking the town, alt. 500 m., *J. W. Gillespie 4558* (Bish, US), Jan. 1928 (common small tree); without further locality, *U. S. Expl. Exped. 1838–42* (G, US, TYPE).

VITI LEVU: Namosi: narrow exposed ridge on Vakarongasiu mountain, *J. W. Gillespie 3275* (Bish), Oct. 1927. Rewa: Suva, Princes Road, *A. Meebold 16692* (Bish), Aug. 1932; slopes of Korobamba mountain, alt. 300 m., *J. W. Gillespie 2258* (Bish, NY), Aug. 1927. Naitasiri: Tamavua woods, 7 miles from Suva, alt. 150 m., *J. W. Gillespie 2149* (Bish), Aug. 1927; Tamavua woods, 7½ miles from Suva, alt. 150 m., *J. W. Gillespie 2448* (Bish), Aug. 1927; vicinity of Nasinu, 9 miles from Suva, *J. W. Gillespie 3481* (Bish, US), Oct. 1927; same locality, *J. W. Gillespie 3627* (Bish, NY), Oct. 1927 (slim tree 8 m. tall); vicinity of Nasinu, 10 miles from Suva, alt. 150 m., *J. W. Gillespie 3667.1* (Bish), Nov. 1927. Tholo North: Nandarivatu, alt. about 830 m., *W. Greenwood 843* (A), May 1941 (tree about 3 m. high; flower-buds white). VITI LEVU: without further locality, *H. E. Parks 20918* (Bish), May-July 1927. FIJI: without further locality, *U. S. Expl. Exped. 1838–42* (*S. amicorum* in part, G).

I am not sure that *S. rubescens* and *S. amicorum* (A. Gray) C. Muell., as interpreted from Fiji, are separable into two species. The specimen in the Gray Herbarium which Dr. Gray designated as *E. amicorum* consists of two parts: (1) a flowering fragment from the Tongatabu collection with a leaf, and (2) a sterile shoot which was probably a portion of the fruiting specimen included in the description of that species. After assembling the material on loan from the Bishop Museum and the U. S. National Herbarium, I believe that most of the Fijian material determined as *S. amicorum* is *S. rubescens*. In the latter the specimens are usually reddish brown when dry, and the venation of the leaves is mostly inconspicuous.

Syzygium rubescens (A. Gray) C. Mueller var. **koroense**, var. nov.

A forma typica differt cortice pallidiore, venulis foliorum utrinque distincte manifestis, inflorescentiis plerumque quam foliis brevioribus, floribus clavatis, paulo congestis.

KORO: main ridge in forest, alt. 300–500 m., *A. C. Smith 1049* (G, NY, US), *1056* (TYPE of var., Gray Herbarium; NY, US), Feb. 1934 (trees 23 and 25 m. high, 5 dm. diameter; filaments white).

The above cited specimens probably represent a new species. However, I should like to see the fruits before describing it. In general appearance the plants suggest *S. rubescens* (A. Gray) C. Muell. But it must be noted that in these the venation of the leaves is more obvious, the inflorescences are shorter than the subtending leaves and not lax, in fact, the axis and branches are stouter, the flowers tend to be crowded, and the calyx is clavate rather than clavate-turbinate.

Syzygium ?amicorum (A. Gray) C. Mueller in Walpers Ann. 4: 839. 1857.

Eugenia amicorum A. Gray, Bot. U. S. Expl. Exped. 1: 524. 1854, as to flowering specimen; Atlas, *pl. 62*. 1857.

VANUA LEVU: Mbua: upper Ndama River Valley, dense forest, alt. 100–300 m., *A. C. Smith 1598* (G), April 1934 (tree 10 m. high; flower buds pale green). Mathuata: southern slopes of Mt. Numbuiloa, east of Lambasa, open forest, alt. 100–350 m., *A. C. Smith 6405* (A), Oct.-Nov. 1947 (tree 20 m. high). Thakaundrove: hills between Vatukawa and Wainingio Rivers, Ndrekeniwai Valley, forest, alt. 200–500 m., *A. C. Smith 592* (G), Nov. 1933 (tree 5 m. high); southwestern slope of Mt. Mbatini, dense forest, alt. 300–700 m., *A. C. Smith 609* (G), Nov. 1933 (tree 18 m. high).

TAVEUNI: western slope, between Somosomo and Wairiki, woods along stream, alt. 300 m., *A. C. Smith 839* (G), Dec. 1933-Jan. 1934 (tree 9 m. high; flowers white; fruit deep purple).

VITI LEVU: Mba: southern slopes of Ndelainathovu, on the escarpment west of Nandarivatu, dense forest, alt. 870–970 m., *A. C. Smith 4938* (A), June 1947 (slender tree 4 m. high; Nandarivatu, alt. about 830 m., *W. Greenwood 844* (A), May 1941 (shrub about 3 m. high; buds pink-tinged); Nandarivatu, valley of the Singatoka, alt. 950 m., *J. W. Gillespie 4028* (Bish), Nov. 1927. Lautoka: mountains near Lautoka, in bed of dry creek on open mountain-side, alt. about 550 m., *W. Greenwood 934* (A),

Oct. 1941 and June 1942 (upright tree about 7 m. high; buds white, second collection in young fruit).

This species needs to be examined, not from the point of view of the type, but with mature specimens from the type locality so that its limits of variation can be estimated. It may not even occur in Fiji. Nevertheless, here I have brought together, as an aggregate, most of the specimens which I have been unable to place elsewhere at present. The collections from Vanua Levu (except *A. C. Smith 592*) and Taveuni were previously determined as *S. curvistylum*, but they differ from that species in that the leaves lack the gradual elongate acumination, the primary veins are more distant from each other, and the calyx-lobes are thinner. It should be noted, however, that they differ from the type-specimen of *S. amicorum* in that the calyx below the globose upper part is very short, not long and slender.

Syzygium malaccense (L.) Merrill & Perry in Jour. Arnold Arb. **19**: 215. 1938; in Sargentia **1**: 78. 1942.

Eugenia malaccensis L. Sp. Pl. 470. 1753.

VANUA LEVU: Mathuata: Mt. Uluimbau ("The Three Sisters"), south of Lambasa, open forest, alt. 150–369 m., *A. C. Smith 6597* (A), Nov. 1947 (tree up to 25 m. high; fruit red at maturity, edible). Thakaundrove: Savu Savu Bay region, Vatunivuamonde Mt., in forest, alt. 0–400 m., *O. Degener & E. Ordonez 14030* (A), Dec.-Jan. 1941.

VITI LEVU: Ra: vicinity of Rewasa, near Vaileka, in forest, alt. 50–200 m., *O. Degener 15501* (A), May-June 1941 (tree 3 m. high). Mba: slopes of escarpment north of Nandarivatu, hillside thickets, alt. 550–800 m., *A. C. Smith 6051* (A), Sept. 1947 (tree 4 m. high; inflorescence on branchlets below leaves; young petals red); same locality, woods along stream, alt. 550–800 m., *A. C. Smith 6293* (A), Sept. 1947 (tree 18 m. high; petals and filaments bright pink; anthers yellow; style white); northern portion of Mt. Evans Range, between Mt. Vatuyanitu and Mt. Natondra, dense forest, alt. 700–900 m., *A. C. Smith 4303* (A), May 1947 (tree 15 m. high; flowers on branchlets below leaves and sometimes associated with leaves; petals, filaments, and carpels rich pink). Lautoka: mountains near Lautoka, in thick bush by creek, alt. about 550 m., *W. Greenwood 356A* (A), Dec. 1944 (young fruit white).

KANDAVU: western end of island, near Cape Washington, open woods, alt. 0–20 m., *A. C. Smith 305* (A), Oct. 1933 (tree 23 m. high; fruit red at maturity, edible).

TUVUTHA: on edge of forested limestone slopes, alt. about 100 m., *E. H. Bryan Jr. 543* (A), Sept. 1924 (tree 5–7 m. high, 20–30 cm. diameter; bark nearly smooth, gray ashy brown; sapwood thick, light brown; heartwood yellow-brown, moderately hard; flowers not seen; fruit green with pink and white, from old wood). FIJI: without further locality, *B. Seemann 161* (G); *U. S. Expl. Exped. 1838–42* (G).

Syzygium neurocalyx (A. Gray) Christophersen in Bishop Mus. Bull. **154**: 27. 1938.

Eugenia neurocalyx A. Gray, Bot. U. S. Expl. Exped. **1**: 512. 1854; Atlas, *pl. 59*. 1857.

KORO: eastern slope of main ridge, in forest, alt. 200–300 m., *A. C. Smith 1008* (A), Jan.-Feb. 1934 (tree 9 m. high; fruit oil used as skin lotion).

VITI LEVU: Rewa: Korumbamba, *A. Meebold 17067* (Bish). Ra: vicinity of Rewasa, near Vaileka, in dense wet forest, alt. 50–200 m., *O. Degener 15520* (A); Rewasa, Mataimeravula, in dark forest, alt. 50–200 m., *O. Degener 15344* (A), May-June 1941 (flowers white; fruit usually red, used as a dye for bark necklaces; leaves and buds used for lung trouble). FIJI: without further locality, *U. S. Expl. Exped. 1838–42* (G, type-collection); *B. Seemann 159* (G); *J. Horne 287* (G).

In the collections above cited the leaves vary considerably in size; some are fairly slender and narrow, as 10.5–32.5 cm. × 2–5 cm., others are wider in proportion to the length, as 16–24 cm. × 5–8.5 cm. All, however, have the same type of flowers. This species is very easily recognized on account of the ribbed calyx.

Syzygium amplifolium, sp. nov.

Frutex vel arbor parva glabra; ramulis teretibus cortice brunnescente, internodiis summis 7–9 cm. longis; foliis coriaceis circiter 45 cm. longis, 17 cm. latis, apice obtusis, basi cordatis, nervis primariis utrinsecus costa circiter 32 supra impressis subtus perspicuis inter se 1–1.5 cm. distantibus, vena intramarginali a margine 5–7 mm. remota conjunctis, rete venularum laxo; petiolo vix 1 cm. longo crasso; tantum uno flore post anthesin viso, terminale, subsessile, axi inflorescentiae vix 5 mm. longo, minute bracteolato; calycis tubo anguste campanulato vel obtuse elongato-obconico, 3.5 cm. longo, basi fere 1 cm., apice 2 cm. diametro, disco crassiusculo, lobis 4, 1–1.4 cm. longis, 2–2.3 cm. latis obtuse rotundatis; staminibus non visis; stylo 5.5 cm. longo basi crassiusculo.

VITI LEVU: Namosi: hills east of Navua River, alt. 200–300 m., *W. Greenwood 981* (Arnold Arboretum, TYPE), May 1943 (scrambly shrub or small tree 15–20 ft. high; leaves in pairs at ends of branches — four pairs biggest number seen; flowers in the fork of the upper pair of leaves; stamens yellow, about 1.5 inches long; style as long as stamens; calyx of four rounded lobes, yellow inside, purple outside; old fruit 1.5 inches across, with three seeds). Rewa: near summit of Korobamba Mountain, alt. 450 m., *J. W. Gillespie 2316* (Bish, sterile specimen).

No other Fijian species has such large leaves. At first the dried flower looked as if it were ribbed something like that of *S. neurocalyx* (A. Gray) Christophersen, but on closer examination the calyx-lobes seemed to be perfectly smooth, and after boiling the flower was smooth; whereas in *S. neurocalyx* the ribs extend up into the lobes and join near the apex.

The type-specimen has only one flower, but a scar indicates that at least one has fallen off.

Syzygium quadrangulatum (A. Gray) Merrill & Perry in Sargentia 1: 77. 1942.

Eugenia quadrangulata A. Gray, Bot. U. S. Expl. Exped. 1: 511. 1854.— Seemann, Fl. Vit. 78. 1865.

Jambosa quadrangulata (A. Gray) C. Mueller in Walpers Ann. **4:** 849. 1857.

OVALAU: common in woods, *U. S. Expl. Exped. 1838–42* (G, US, type-collection).

VITI LEVU: Ra: vicinity of Rewasa, near Vaileka, dense forest, alt. 50–200 m., *O. Degener 15382* (A), May-June 1941. Mba: southern slopes of Mt. Ndelainathovu, on escarpment west of Nandarivatu, dense forest, alt. 870–970 m., *A. C. Smith 4939* (A), June 1947 (slender tree 4 m. high; fruit red, about 4 cm. × 2 cm. when fresh). FIJI: without further locality, *Horne 340* (G).

In the original description of this species the cotyledons are described as "thickened, corneous, united." As a matter of fact the two cotyledons of a seed in the pocket on the specimen at the Gray Herbarium have separated. Only one other mature fruit is in the pocket and that I hesitate to open. From the contour of the matching faces it looks as if the seed might have had a long radicle.

Syzygium Richii (A. Gray) Merrill & Perry in Sargentia 1: 77. 1942.

Eugenia Richii A. Gray, Bot. U. S. Expl. Exped. **1:** 510. 1854; Atlas, *pl. 58.* 1857. — Seemann, Fl. Vit. 77. 1865.

Jambosa Richii C. Muell. in Walpers Ann. **4:** 849. 1857.

VITI LEVU: without further locality, sea beach, *B. Seemann 165* (G). Nandronga & Navosa: beach at Thuvu, Singatoka, *W. Greenwood 785A* (A), May 1947 (usually very spreading shrub 6–8 ft. high, but does grow into tree 20 ft. high with spreading top when out of wind; flowers large, yellow, on older branches in large clusters). FIJI: without further locality, *U. S. Expl. Exped. 1838–42* (G, US, type-collection), *J. Horne 1081* (G).

When Dr. A. Gray described this species he noted that he had some specimens with large ovate leaves and others with more commonly oblong acutish smaller leaves. Dr. B. Seemann indicated that here was a species and a small-leaved variety, unless these should later turn out to be two species. I believe that this is a problem still to be solved by someone who is in the field and can observe the habit of these trees in their native habitat. Possibly some character, veiled or lacking in the dried specimens, can be found in the growing trees. More knowledge of the color of the flowers and fruits might help. The specimens cited above are only those with coriaceous broadly ovate acutish leaves. It is to be noted that only one (from the beach at Thuvu) is a comparatively recent collection. Seemann commented "common on the sea-beach. . . ." But are these confined to the sea-beach?

The other collections cited below are those with chartaceous (or thinly coriaceous) oblong-elliptic and often acute leaves. The field notes do not suggest that these are beach plants. But, could it be that these are two forms of one species responding to different environments, or are two species involved?

VANUA LEVU: Mathuata: southern slopes of Mt. Numbuiloa,

east of Lambasa, in open forest, alt. 100–350 m., *A. C. Smith 6360* (A), Oct.-Nov. 1947 (tree 18 m. high; old calyx-lobes pink-tinged). Mbua: Upper Ndama River Valley, in dense forest near streams, alt. 100–300 m., *A. C. Smith 1693* (G, US), April 1934 (tree 10–15 m. high; calyx white, pink-tinged; petals and filaments white). Thakaundrove: Savu Savu Bay region, along stream in pasture, alt. 0–150 m., *O. Degener & E. Ordonez 13884* (A, US), Dec. 1940 (tree 25 ft. high; fruit red).

VANUA MBALAVU: northern limestone section, forest, alt. 0–200 m., *A. C. Smith 1498* (G, US), April 1934 (tree 9 m. high; petals cream-white; filaments yellow).

VITI LEVU: Nandronga & Navosa: northern portion of Rairaimatuku Plateau, between Nandrau and Rewasau, dense forest, alt. 725–825 m., *A. C. Smith 5619* (A), July-Aug. 1947 (tree 20 m. high; fruit on branchlets below leaves, pink-tinged). Tholo West: vicinity of Mbelo, near Vatukarasa, *O. Degener (Aloisio Tabualewa) 15641* (A), May 1941 (tree 2 m. high). Namosi: between Namosi and Navua River, *B. Seemann 164* (G). Ra: vicinity of Rewasa, near Vaileka, in dense forest, alt. 50–200 m., *O. Degener 15490* (A, US), May-June 1941. Lautoka: mountains near Lautoka, alt. about 600 m., *W. Greenwood 959* (A), Sept. 1942 (tree 8 m. high; flower-buds white); Mt. Evans, by edge of creek, alt. about 750 m., *W. Greenwood 1158* (A), Sept. 1945 (spreading tree 5 m. high; flower-buds white).

MOALA: forest near Maloku, *A. C. Smith 1380* (G), Mar. 1941 (tree 10 m. high; petals white; filaments bright yellow).

KAMBARA: limestone formation, in forest, alt. 0–100 m., *A. C. Smith 1255* (G, US), Mar. 1941 (tree 17 m. high; petals and filaments cream-white). Fiji: without further locality, *U. S. Expl. Exped. 1838–42* (G).

In *A. C. Smith 5619* and *O. Degener 15490* the leaves tend to be narrowed in the lower part, but for the present it seems as if they might belong with this complex.

Syzygium nandarivatense (Gillespie), comb. nov.

Eugenia nandarivatensis Gillespie in Bishop Mus. Bull. **83**: *22, fig. 27.* 1931.

VITI LEVU: Tholo North: vicinity of Nandarivatu, escarpment north of the Government Station, alt. 400 m., *J. W. Gillespie 3972* (Bish, type-collection); slopes of the escarpment north of Nandarivatu, hillside thickets, alt. 550–800 m., *A. C. Smith 6065* (A), Sept. 1947 (tree 4–6 m. high; inflorescence terminal on short leafy branches arising from branchlets below leafy shoots; flower-buds greenish yellow).

KANDAVU: Mt. Mbuke Levu, dense forest, *A. C. Smith 236* (G, US), Oct. 1933 (tree 4 m. high; fruit red).

The compound branching of the inflorescence (branches of the third order) suggests *S. Richii* (A. Gray) Merrill & Perry, but the flower (post anthesis) is slender and much more like that of *S. gracilipes* (A. Gray) Merrill & Perry. *Smith 236* was collected from Mt. Mbuke Levu, surely very close to the type-locality of *Eugenia vitiensis Turrill*, i. e., *S. gracilipes*. It might possibly be that this is an intermediate form between *S. gracilipes* and *S. Richii.*

Syzygium gracilipes (A. Gray) Merrill & Perry in Sargentia **1**: 78. 1942.

Eugenia gracilipes A. Gray, Bot. U. S. Expl. Exped. **1**: 513. 1854. — Seemann, Fl. Vit. 78, *pl. 15.* 1865.

Jambosa gracilipes C. Mueller in Walpers Ann. **4**: 849. 1857.

Eugenia vitiensis Turrill in Jour. Linn. Soc. Bot. **43**: 21. 1915.

Syzygium vitiense (Turrill) Merrill & Perry in Sargentia **1**: 78. 1942.

TAVEUNI: banks of streams in coconut plantation, vicinity of Waiyevo, *J. W. Gillespie 4791* (Bish).

OVALAU: mountains behind Levuka, alt. 400 m., *J. W. Gillespie 4450* (Bish), Jan. 1928 (fruit red).

VITI LEVU: Tholo West: Mbuyombuyo, near Namboutini, *O. Degener* (*A. Tabualeva*) *15591* (A, US), *15606* (A, US), June 1941 (tree 1 m. high; fruit bright red). Serua: vicinity of Ngaloa, Vatuvilakia, in dense forest, alt. 0–150 m., *O. Degener 15142* (A), Apr.-May 1941 (tree 3 m. high; fruit pendent). Namosi: Naitaradamu Mountain, alt. 800 m., *J. W. Gillespie 3087* (Bish); narrow exposed ridge on Vakarongasiu Mountain, alt. 800 m., *J. W. Gillespie 3274* (Bish). Rewa: southeast slope of Korombamba Mountain, alt. 350 m., *J. W. Gillespie 2244* (Bish); limestone hills near the quarry beyond Lami village, *J. W. Gillespie 4608* (Bish). Naitasiri: vicinity of Nasinu, 9 miles from Suva, alt. 150 m., *J. W. Gillespie 3476.5* (Bish, US). Tailevu: forest above Waimaro Road, *B. E. Parham 3031* (A). Mba: Lomalangi, in dense bush, alt. 1400 m., *H. E. Parks 20751* (Bish), July 1927 (shrub 3 m. high; flowers few, yellow, pendulous); slopes of Mt. Nairosa, eastern flank of Mt. Evans Range, dense forest, alt. 700–1050 m., *A. C. Smith 4078* (A), April-May 1947 (slender tree 2 m. high; calyx pink; petals white; filaments yellow); eastern slopes of Mt. Koroyanitu, Mt. Evans Range, alt. 950–1050 m., dense low forest, alt. 950–1050 m., *A. C. Smith 4148* (A), May 1947 (slender tree to 5 m. high, sparsely flowering; calyx dull pink; petals white, at length pink-tinged; filaments pale yellow); northern portion of Mt. Evans Range, between Mt. Vatuyanitu and Mt. Natondra, dense forest, alt. 700–900 m., *A. C. Smith 4305* (A), May 1947 (slender tree 10 m. high; fruit deep purple); western slopes of Mt. Nanggaranambuluta [Lomalangi], east of Nandarivatu, dense forest, alt. 1000–1100 m., *A. C. Smith 5670* (A), June-Aug. 1947 (slender tree 5 m. high; old calyx distally reddish; style red); slopes of the escarpment north of Nandarivatu, woods along stream, alt. 550–800 m., *A. C. Smith 6057* (A), Sept. 1947 (tree 5 m. high; calyx and petals yellowish with pink tinge; filaments pale yellow; style pale green); Nauwanga, vicinity of Nandarivatu, dense forest, alt. 750–900 m., *O. Degener 14808* (A), Feb.-Mar. 1941 (tree about 2 m. high; fruit red, globose-pyriform, about 4 cm. diameter and 3- or 4-seeded; seeds about 1.5 cm. diam.); Mt. Matomba, Nandala, vicinity of Nandarivatu, in dense rich forest, alt. 750–900 m., *O. Degener 14433* (A), Feb. 1941 (spreading tree 3 m. high). Lautoka: Mt. Evans, alt. about 820 m., *W. Greenwood 82A* (A), Oct. 1942 (tree 4 m. high; flowers yellow); Mt. Evans, on edge of creek, alt. about 750 m., *W. Greenwood 82B* (A, Bish), Sept. 1945 (tree 5 m. high; flowers bright yellow); north of Lomolomo, dense forest, alt. 0–150 m., *O. Degener & E. Ordoñez 13638* (A, US), Dec. 1940 (shrub 2 ft. high, spreading; fruit pink). FIJI: without further locality, *Seemann 158* (G); *U. S. Expl. Exped. 1838–42* (US, not in G); *W. H. Harvey* (G).

Among the specimens cited, so much variation in the diagnostic characters has been found that I am convinced that only one species is represented. Through the courtesy of Dr. H. Emory Moore, Jr., of Ithaca, N. Y., I have received a photograph of *Eugenia vitiensis* Turrill. Turrill compared his species with *S. gracilipes* (A. Gray) Merrill & Perry, noting three differences: the rounded, not slightly cordate, leaf-base, the shorter and more robust pedicels, and the size of the flower. In comparing the descriptions of the flowers I cannot see much difference in the size. As for the other two differences, they are not always correlative; further, the specimen *Smith 4305* has leaves on one branchlet which are slightly cordate and some on another branchlet with a rounded base, which leads me to think the character cannot stand very well alone. As for the slender or robust pedicels, these vary so greatly that it would be difficult to say where one begins and the other ends.

Mostly, the inflorescence consists of an axis and branches, each terminated by a single flower. In some instances it consists of a single flower at the end of a long slender axis.

Syzygium Jambos (L.) Alston, Handbk. Fl. Ceylon 6(Suppl.): 115. 1931. — E. Christophersen in Bishop Mus. Bull. 154: 27. 1938.

Eugenia Jambos L. Sp. Pl. 470. 1753. — F. Brown in Bishop Mus. Bull. **130**: 202. 1935.

VITI LEVU: Mba: western and southern slopes of Mt. Tomanivi [Mt. Victoria], thickets, near sawmill at Navai, alt. about 750 m., *A. C. Smith 5141* (A), July-Sept. 1947 (tree 10 m. high; petals and filaments pale yellow; calyx dull red).

Native name: kavika ni vavalangi. According to Dr. Smith's note this is the "foreigner's Kavika," the name suggesting a recent introduction. In 1938 Dr. Christophersen reported it in cultivation in Samoa, and in 1935 Dr. Brown indicated that it was relatively new in the Marquesas.

Syzygium Gillespiei Merrill & Perry in Sargentia 1: 78. 1942.

No further material of this species has been found in the collections at hand.

Syzygium tetrapleurum, sp. nov.

Frutex 3 m. vel arbor 6 m. alta, glabra; ramulis quadrangularibus marginatis deinde interdum subteretibus; cortice cinereo novello pallide brunnescente; foliis chartaceis oblongis, 11–14 cm. longis, 3–4.5 cm. latis, in frutice 5.5 × 1.5 cm., 7 × 3.5 cm., 10 × 3.5 cm., apice obtusis vel interdum acutiusculis, basi cuneatis et decurrentibus, nervis primariis utrinsecus 8–10 patenti-ascendentibus prope marginem arcuatim conjunctis, supra manifestis, subtus prominulis, venulis et rete venularum inconspicuis; petiolo 1–2.5 cm. longo, dorso rotundato, supra plano; paniculis terminalibus anthesi circiter 12 cm. longis latisque, axi et ramulis quadrangularibus vel valde compressis; floribus in apice ramulorum 3 vel 1, sessilibus vel subsessilibus; alabastro turbinato; calyce in sicco 1.8–2 cm. (basi 3 mm. stipitato incluso) longo, apice vix 1 cm. lato, lobis 6 mm. latis,

3 mm. longis, rotundatis, persistentibus; petalis singulatim caducis; staminibus fere 3 cm. longis, antheris 1.5 mm. longis, 0.5 mm. latis; stylo 2.5 cm. longo; fructibus subglobosis in sicco 2 cm. diametro, apice calycis tubo (circiter 8 mm. lato) et lobis coronatis; seminibus 2, radicula longa.

VITI LEVU: Mba: immediate vicinity of Nandarivatu, dense forest along stream, alt. 800–900 m., *A. C. Smith 5044* (A), June-Oct. 1947 (slender tree 6 m. high; petals and filaments pale yellow); same locality, thickets, *A. C. Smith 5741* (Arnold Arboretum, TYPE), June-Oct. 1947 (shrub 3 m. high; fruit becoming red).

The obvious characters of this species are the very pale (when dry) oblong obtuse leaves, the subglobose fruits, and the sharply angled grayish branchlets. I have chosen the fruiting specimen as the type, as it shows three years' growth; the oldest growth is barely 4-angled, last year's branchlets are sharply margined and grayish in color, while those of the new growth are brownish and very narrowly winged. It is to be noted, however, that the branchlet of the flowering specimen (30 cm. long attached to one trimmed to 4 cm.) is only inconspicuously angled.

Syzygium tetrapleurum has in common with *S. Gillespiei* Merrill & Perry the long petiole of the leaves. But the two are readily distinguished by the shape of the fruit. In the latter it is obovoid, the apex constricted around the disk and the calyx-lobes spreading, and the base somewhat pointed. In *S. tetrapleurum,* on the other hand, the constriction around the disk at the apex of the fruit is less marked and the calyx-lobes smaller and often incurving; the base is rounded.

Two other specimens in this collection have a close affinity here. *A. C. Smith 4201,* collected in the dense ridge forest and thickets on the summit of Mt. Koroyanitu, high point of Mt. Evans Range, alt. 1165–1195 m., has a sharply angled and margined branchlet similar to that of the type of *S. tetrapleurum,* but the leaves are acute and broadest near the base which tends to be rounded. The flowers are sessile and not stipitate. The other specimen, *A. C. Smith 4858,* has compressed branchlets, oblong-elliptic leaves, the margins equally incurving towards the apex and the base, with the base subrounded and the apex very shortly acuminate. This specimen has two fruits which, in the pressing, look as if the calyx were accrescent, but on dissection the latter appears to be a long disk with the calyx-lobes not unduly large. In species which vary as widely as those of this genus appear to do in Fiji, more material is necessary to place these specimens.

Piliocalyx wagapensis Brongniart & Gris in Bull. Soc. Bot. France 13: 471. 1866; in Ann. Sci. Nat. sér. 5, 6: 263. 1866.

VITI LEVU: Nandronga & Navosa: northern portion of Rairaimatuku Plateau, between Nandrau and Nanga, dense forest, alt. 725–825 m., *A. C. Smith 5467* (A), Aug. 1947 (tree 15 m. high; fruit pink). Mba: northern portion of Mt. Evans Range, between Mt. Vatuyanitu and Mt. Natondra, dense forest, alt. 700–900 m., *A. C. Smith 4373* (A), May 1947 (tree 20 m. high; fruit becoming dull pink); western and southern slopes

of Mt. Tomanivi [Mt. Victoria], dense forest, alt. 850–1150 m., *A. C. Smith 5118* (A), July-Sept. 1947 (tree 25 m. high; fruit dull pink); hills between Nandala and Nukunuku Creeks, along trail from Nandarivatu toward Lewa, edge of forest, alt. 750–850 m., *A. C. Smith 6155* (A), Sept. 1947 (tree 5 m. high, with dense foliage; flower-buds white); vicinity of Nandarivatu, dense forest, alt. 750–900 m., *O. Degener 14532* (A, NY), Feb.-Mar. 1941 (tree; fruit greenish white, pinkish at apex).

These collections are very much like the material we have of this New Caledonian species. The fruits certainly suggest the genus *Acmena* in appearance and in the structure of the seed; however, *Smith 6155,* which is the only specimen with flower-buds, furnishes the clue to the New Caledonian genus *Piliocalyx.* The buds are closed, the apex being apparently circumscissile, the stamens seem to have didymous anthers, and the ovules on the axile placentae are pendent from the apex of the locules. I have not found any previous record of the occurrence of this genus in Fiji.

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THE MORPHOLOGY AND RELATIONSHIPS OF THE MONIMIACEAE

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With four plates and three text-figures

INTRODUCTION

The Monimiaceae, like the Icacinaceae, is a family which exhibits unusually wide ranges of morphological variability in all of its organs and parts, both vegetative and reproductive. In the case of this family, as also in that of the Icacinaceae, anatomical characters were utilized as an aid in subdividing it into sub-families and tribes. Therefore, there is a historical taxonomic precedent for dealing with the Monimiaceae from the point of view of internal, as well as of external, morphological characters.

Recent investigations of the vesselless genus *Amborella,* Bailey and Swamy (1), and of *Austrobaileya,* Bailey and Swamy (2), have strengthened our opinion that the Monimiaceae is a key family in understanding and in interpreting the morphology, not only of the Lauraceae, Gomortegaceae, and Hernandiaceae, but also of the Chloranthaceae, Swamy and Bailey (19), and probably of other dicotyledonous families. Therefore, it seems desirable to summarize in the following pages data that we have accumulated during an interval of more than ten years.

HISTORICAL

The most significant investigations of the anatomy of the vegetative parts of the Monimiaceae are those of Hobein (8), Perkins (13), Solereder (17) and Garratt (6). Hobein examined the leaves and twigs of fifteen genera, devoting particular attention to (1) such foliar structures as the hairs, stomata, hypodermis, secretory cells, etc., and (2) the width of the rays and the occurrence of schlerenchyma in young stems. Hobein's data regarding ray widths were utilized by Pax (12) in characterizing and differentiating the two subfamilies Monimioideae and Atherospermoideae, his data regarding foliar characters in distinguishing tribes and genera. Hobein's types of structural data were extended by Perkins to include thirteen additional genera. Solereder, in addition to summarizing the observations of previous investigators, recorded the results of his detailed study of the xylem in seven species of seven genera. Garatt examined the older wood of thirty species of twelve genera.

MATERIAL

In her revision of the Monimiaceae, Perkins (14) listed thirty-one genera as representatives of this family. We have examined herbarium

material of all of these genera with the single exception of *Lauterbachia.* Of genera that have subsequently been referred to the family (*Hedycaryopsis, Decarydendron, Schrameckia, Bracteanthus, Dryadodaphne, Idenburgia, Scyphostegia, Canaca* and *Kibaropsis*) we have studied seven, having been unable thus far to obtain material of the last two. In this connection, we are much indebted to Professor H. Humbert, Director of the Museum of Natural History in Paris, for his kindness in loaning us herbarium specimens of *Amborella, Carnegieodoxa, Hedycaryopsis, Schrameckia,* and *Decarydendron.*

In addition to leaves, stems and nodes, we have studied the pollen of all genera of the Hortonieae, Trimenieae, and Monimieae, of eight genera of the Mollinedieae, and of seven genera of the Atherospermoideae. The pollen of *Idenburgia* and *Scyphostegia* has been examined for comparative purposes. We are indebted to Sir Edward Salisbury, Director of the Royal Botanic Gardens at Kew, for his courtesy in sending us male flowers of *Amborella, Tetrasynandra* and *Tambourissa.*

In the case of sixteen genera, wood from large stems was available for comparison with the xylem of young twigs. We are indebted to Professor Robert W. Hess for his kindness in sending us cuttings of samples in the wood collections of Yale University.

Approximately 1500 permanent slides have been made utilizing techniques that are commonly employed in anatomical investigations of leaves, stems, nodes and pollen. Collectors' names and numbers have been recorded for purposes of future taxonomic verification.

Detailed descriptions of the leaves, nodes, stems and pollen (together with 179 drawings and photomicrographs) of the Monimiaceae have been incorporated by one of us, Money, in a doctoral dissertation, "The anatomy and morphology of the Monimiaceae," which is deposited in the Library of Radcliffe College for future reference. Of the extensive data compiled in this volume, only those which are particularly significant in discussions of major aspects of phylogeny and classification can be dealt with in the following pages.

The totality of anatomical and morphological evidence demonstrates that *Idenburgia* and *Scyphostegia* do not belong in the Monimiaceae. Nor do they exhibit evidences of close relationship to this family. Therefore, we shall deal with thirty-five of the thirty-eight genera that belong in, or are closely related to, the Monimiaceae.

LEAF

The exstipulate, pinnately veined, commonly aromatic leaves of the Monimiaceae usually, but not invariably (e.g. *Amborella, Glossocalyx*), are arranged in a decussate phyllotaxy. The aromatic character of the leaves is due, as in many other families of the Ranales (*sensu lato*), to the presence of characteristic "ethereal oil cells." Such secretory cells occur in the leaves of all species and genera that we have examined with the exception of *Amborella* and *Macropeplus.* However, their absence

in these two genera needs to be verified by examination of more adequately preserved material. The ethereal oil cells, as noted by previous investigators, are formed in the mesophyll, and at times in the epidermis or hypodermis.

Foliar hairs, when present, are unicellular except in the case of *Amborella* which forms both unicellular and multicellular trichomes, Bailey and Swamy (1). They occur singly, in small clusters of two, three or four, or in larger aggregates of tufted, fan-shaped, stellate or peltate forms. Although trichomes occur on the leaves of at least some species of all of the genera that we have studied, with the exception of *Xymalos, Macrotorus, Macropeplus* and *Schrameckia,* the types of hairs present vary greatly not only from tribe to tribe, but also within the same tribe and in certain cases within a genus or species.

The anticlinal walls of the epidermal cells are straight except in *Peumus, Piptocalyx, Glossocalyx* and certain species of *Trimenia* and *Kibara* where they are more or less conspicuously wavy or undulating. The stomata are of two types: (1) "syndetocheilic," viz. having subsidiary cells oriented parallel to the guard cells, and (2) "haplocheilic," viz. surrounded by ordinary epidermal cells. Stomata of the former type predominate in the Hortonieae, Trimenieae, Mollinedieae and Siparuneae, those of the latter type in the Laurelieae. The Monimieae are intermediate or transitional between "syndetocheilic" and "haplocheilic," *Tambourissa, Hennecartia* and *Schrameckia* having stomata mostly of the former type, and *Monimia* and *Palmeria* those of the latter type.

A one-, two- or three-layered hypodermis, composed of cells that commonly are distinctly larger than those of the epidermis, is characteristic of most genera with the exception of *Piptocalyx, Matthaea, Daphnandra, Bracteanthus, Atherosperma* and *Glossocalyx.* Palisade parenchyma usually is clearly differentiated except in *Amborella, Trimenia, Piptocalyx,* and *Glossocalyx.* The mesophyll is loosely organized with relatively large intercellular spaces except in *Amborella, Trimenia,* and *Piptocalyx.* Idioblasts, other than ethereal oil cells, are of rare occurrence in the mesophyll, e.g. stone cells in *Wilkiea macooraia* (Baill.) Perkins (*Brass 2265*). It is significant in this connection, however, that large "mucilage cells" are formed in both the leaves and stems of *Trimenia* and *Piptocalyx,* a structural feature that has been utilized previously as a reliable criterion in differentiating the Lauraceae from the Monimiaceae.

The variating venation pattern of the lamina resembles that of several other dicotyledonous families, and the degree of jacketing of the veins and veinlets by thick-walled cells varies greatly even within tribes and genera. The vascularization patterns of the petiole and costa will be considered in connection with the nodal anatomy of the family.

The occurence, form and distribution of crystals of calcium oxalate vary markedly, not only within tribes and genera, but also within species, at least in certain cases. When present, the crystals are relatively small and commonly are of diversified form, acicular, elongated prismatic,

cubical, etc. Usually, several to many of these minute crystals are formed in each crystal-bearing cell. Druses and large solitary crystals do not occur in any of the thirty-five genera that we have studied.

STEM–XYLEM

In the case of the leaf, one is handicapped at present, in discussions of phylogeny and relationships, by the fact that there is no reliable or conclusive evidence regarding the external form and the internal structure of primitive dicotyledonous foliage. Fortunately, this is no longer true of the xylem of the stem and root, extensive surveys of the dicotyledons and monocotyledons during the last thirty-five years having provided an accurate picture of the primitive structure and the salient trends of specialization of the xylem in angiosperms.

In primitively vesselless dicotyledons, viz. Winteraceae, Trochodendraceae, Tetracentraceae, *Amborella* of the Monimiaceae, and *Sarcandra* of the Chloranthaceae, the fusiform initials of the cambium are very long with extensively overlapping ends, as in vesselless gymnosperms. These initials form long tracheids with intertracheary pitting in their radial walls that varies between scalariform, opposite multiseriate, alternating multiseriate, and uniseriate with more or less widely spaced, circular bordered pits, the percentages of the different types of pitting varying greatly in different genera and species and not infrequently in different parts of the same plant. The scalariform and multiseriate types of pitting tend to occur in thinner walled tracheids of larger cross-sectional area, whereas the scanty circular type predominates in thicker walled tracheids of smaller cross-sectional area.

Vessels originated in the secondary xylem of dicotyledons, as in the metaxylem of monocotyledons and *Pteridium*, by the dissolution of pit membranes in the overlapping ends of scalariformly pitted tracheids. With the advent of vessels, in a diffusely distributed pattern, the intervening imperforate tracheids become dominantly of the thicker walled, circular bordered pitted type, commonly having more or less numerous pits in both their radial and their tangential walls. Thus, two trends of specialization are initiated in tracheids of primitive dicotyledons, (1) successive structural changes which facilitate the movement of water, and (2) structural changes which emphasize the mechanical function of imperforate tracheary cells. In the former trend of evolutionary specialization, the vessel members become less and less tracheid-like by a succession of more or less closely coordinated morphological changes. They become shorter and shorter as a concomitant of reduction in length of the fusiform initials of the cambium. At the same time by greater lateral expansion during tissue maturation, they acquire a proportionally larger cross-sectional area in comparison with the imperforate tracheary cells. These modifications of longitudinal and transverse dimensions lead to the formation of vessel-members with less and less extensively overlapping ends, and the perforated facets ("perforation plates") assume a more

nearly transverse orientation. During the course of such phylogenetic changes, the perforated pits (scalariform) tend to lose their borders, to increase in size, to be reduced in number, and eventually to be replaced by a single oval or circular perforation. Furthermore, during the initial stages of the evolutionary progression, the vessels tend to be diffusely distributed — except at times in close proximity to the metaxylem — lateral contacts between vessels being of infrequent or sporadic occurrence, whereas subsequently they commonly exhibit a tendency to become aggregated in clusters, at least in part. The intervascular pitting, viz. in the lateral walls of contacting vessels, at first is scalariform and subsequently is replaced by more or less circular bordered pits in opposite and ultimately in alternating seriations.

As the specialization of vessels progresses, the imperforate tracheids commonly tend to assume a more fiber-like form by greater elongation and reduced lateral expansion during tissue maturation, and by reduction in size of the circular bordered pits and by elimination of their borders; a phylogenetic progression leading from thick-walled tracheids to fiber tracheids and finally to libriform fibers.

These coordinated changes in the cambium and in two categories of its tracheary derivatives are uni-directional and irreversible. However, their synchronization varies from family to family since any one of them may be accelerated or retarded in relation to the others. It should be emphasized in this connection that *it is such chronological deviations in salient trends of parallel evolution that provide one of the means of differentiating and identifying the woods of different dicotyledonous families.*

The major trends of structural specialization of wood parenchyma and of wood rays are more diversified and complex. Although the length and the form of wood parenchyma strands are determined largely by the fusiform initials of the cambium, phylogenetic changes in the patterns of distribution of wood parenchyma may or may not be closely correlated with salient trends of specialization in the cambium and its tracheary derivatives.

A study of the vesselless dicotyledons and statistical analyses of data obtained from the dicotyledons as a whole, Kribs (9), clearly demonstrate that the primitive distributional pattern of wood parenchyma is diffuse, and that the aggregation of parenchyma strands in banded apotracheal, metatracheal (Sanio) and abundant paratracheal patterns occurs in plants which have attained a relatively high level of specialization of their tracheary tissue. Elimination of wood parenchyma or its reduction to scanty paratracheal or terminal may occur at any level of the structural specialization of vessels. Where wood parenchyma is eliminated or greatly reduced in amount, all or part of the imperforate tracheary cells not infrequently retain their living contents during tissue maturation, commonly becoming septate and assuming a storage function in addition to a largely mechanical one.

The rays of primitive dicotyledons are of two types: (1) multiseriates which extend outward in young stems from the interfascicular parts of

the eustele, and (2) uniseriates which originate in the fascicular parts. Both types of rays are longitudinally extensive when first formed, but become dissected into lower rays by cambial changes during subsequent enlargement of the stem. Certain of the uniseriate rays widen to form new multiseriates and new uniseriates are formed by septation of fusiform initials of the cambium, such cambial modifications serving to maintain the ratio of wide to narrow rays in the later formed part of the stem or root. The uniseriate rays — whether independent or attached to the upper or lower margins of multiseriate rays — are composed of extensively upright cells. The multiseriate rays when first formed in young stems are composed of less extensively upright cells or of cells having more nearly equivalent vertical and radial dimensions. During subsequent extension of the multiseriate rays in an enlarging stem, the percentage of upright cells decreases and all or part of the ray cells become more or less procumbent, i.e. develop larger radial diameters.

As demonstrated by Kribs (10) and particularly by Barghoorn (3, 4), this primitive type of ray structure is modified in dicotyledons by a number of different phylogenetic trends of specialization. Especially significant are (1) reduction in the width and height, and ultimately the elimination, of multiseriate rays, and (2) the elimination of uniseriate rays, (3) simultaneous reduction in size of multiseriate rays and widening of uniseriate rays, yielding small multiseriate rays of relatively uniform size, and (4) transformation of upright ray cells to excessively procumbent ones culminating in the so-called homogeneous type of ray structure.

It should be strongly emphasized at this point that the salient trends of evolutionary specializations within the secondary xylem, particularly of vessels and rays, cannot be fully and accurately visualized without studying the tissues formed by a changing cambium at successive stages of the enlarging stem or root. It other words, data obtained by the study of small twigs from herbarium specimens (Hobein, Perkins) cannot be reliably compared with those secured from the later-formed wood of older stems (Garratt) without full recognition, or the interpolation, of structural changes that occur during the ontogenetic development of a woody axis. *What is needed in the study of the evolution of the angiosperms is a reliable phylogeny of successively modified ontogenies.*

The various genera that have been assigned to the Monimiaceae provide an unusually extensive and significant illustration of successive phylogenetic changes that occur during the early evolutionary specializations of dicotyledonous xylem.

The genus *Amborella* of the tribe Hortonieae has retained a primitive type of cambium and a vesselless xylem, having very long extensively overlapping fusiform initials, correspondingly long tracheids with pitting in their radial walls that varies from scalariform to circular, and scanty diffusely distributed wood parenchyma. A large majority of the rays in the wood of young stems — no older material is available — are uniseriate and biseriate, but broader rays, three to five cells in width, are of not

infrequent occurrence. The narrower rays are vertically extensive and are composed of much elongated upright cells. The multiseriate rays, which extend outward from conspicuous interfascicular parts of the eustele, have less extensively upright cells or cells of nearly equivalent vertical and radial dimensions. It should be noted in this connection, however, that the wood of young stems of *Amborella* differs from that of comparable specimens of other vesselless dicotyledons in having a reduced number of multiseriate rays.

The genus *Hortonia* exemplifies early stages in the specialization of vessel-bearing xylem, although certain changes that have occurred in the pitting of the vessels and in the rays obviously are precocious. The fusiform initials of the cambium are relatively long with extensively overlapping ends, as are the thin-walled, angular, vessel members. The scalariformly perforated facets of the latter elements are steeply inclined, and the perforated pits are numerous and retain vestiges of borders. The vessels of the later formed wood are diffusely distributed and solitary, lateral contacts between vessels being of infrequent or sporadic occurrence, except at times in the xylem of twigs. The pitting between vessels and rays or wood parenchyma varies from scalariform to transitional and multiseriate. On the contrary, intervascular pitting, when present, tends to be predominantly of the nearly circular multiseriate type. The imperforate tracheids have conspicuously bordered pits both in their radial and tangential walls. These bordered pits resemble those that occur in the thicker-walled tracheids of *Amborella*. The slitlike apertures commonly are "included," but may be considerably extended at times by helical cracking of the secondary wall during drying or sectioning of the wood. The wood parenchyma strands are long, abundant and distributed in the so-called diffuse-in-aggregates pattern. The rays in the wood of young stems vary in width from one to five cells, the percentage of wider rays (3–5 cells in width) being relatively low in the internodal regions of the stem, but somewhat higher in the nodal parts. The multiseriate rays appear relatively narrow in transverse and tangential sections of the stem, owing to the fact that their constituent cells are upright and have narrow tangential diameters. The numerous uniseriate rays are composed of more extensively upright or erect cells. In contrast to young stems, the wood from the outer parts of older stems has predominantly multiseriate rays — the broadest of which may be from seven to nine cells wide — and a proportionally reduced number of high-celled uniseriate rays. The cells of the multiseriate rays vary markedly in form from upright to nearly isodiametric to conspicuously procumbent, the percentages of the various types of cells varying in different rays and at different stages of the ontogenetic development of the same ray. The upright cells tend to occur on the upper and lower margins and along the sides of the rays. These cells, and the more nearly isodiametric and slightly procumbent ones of the interior of the rays, have broad tangential diameters, whereas the interspersed radially much elongated cells are slender in planes at right

angles to their major axis. The multiseriate rays appear to be relatively broad under a hand lens owing to the fact that they are composed largely of cells which have a wide tangential diameter. Ethereal oil cells occur both in the rays and in the wood parenchyma.

Three other genera of the Hortonieae, *Hedycarya, Levieria,* and *Decarydendron,* have cambia and vessels that have attained a general level of specialization comparable to that of *Hortonia.* The thin-walled, angular vessel members are relatively long with extensively overlapping ends and numerous scalariform perforations. However, the vessels of the three genera differ from those of *Hortonia* in two respects. There is a more precocious tendency toward the formation of radial pore multiples (even in wood from the outer part of old stems of *Hedycarya* — no older wood of *Levieria* and *Decarydendron* is available) and a less precocious modification of the intervascular pitting which tends to be predominantly scalariform and transitional rather than prevailingly of the alternating multiseriate type. The distribution of wood parenchyma is vestigial diffuse and scanty paratracheal. The imperforate tracheary cells are septate and transitional between fiber tracheids and libriform fibers. The more or less vestigially bordered pits are largely confined to the radial walls and to walls of contact with parenchymatous cells. Pits between septate fibers and vessels are much reduced in number. The rays in the first-formed secondary xylem, and in the subsequently formed wood of *Hedycarya,* are predominantly multiseriate, uniseriate rays being much reduced both in number and height. When first formed, the rays are composed of more or less upright cells. The rays appear wider in transverse sections than in comparable material of *Hortonia* owing (1) to the reduction in number of uniseriate rays, (2) to the occurrence of a higher percentage of rays 4–6 cells wide, and (3) to their frequently being composed of cells having broader tangential diameters. In the later formed wood of *Hedycarya,* the multiseriate rays — the broadest of which may be from 8–16 cells wide — tend to be conspicuously heterocellular. Their constituent cells vary markedly in form, as in comparable material of *Hortonia,* from upright to isodiametric to procumbent.

In the remaining genus, *Peumus,* of the Hortonieae, the specializations of the wood parenchyma (scanty paratracheal), of the imperforate tracheary elements (septate fibers) and of the rays (predominantly heterocellular multiseriate) have attained phylogenetic levels comparable to those in *Hedycarya.* However, the ray cells in young stems are less extensively upright, and in the wood of older stems there commonly is a higher ratio of procumbent cells in the multiseriate rays which attain a breadth of only 5–7 cells. The vessels are thicker walled and less angular than those of other vessel-bearing representatives of the Hortonieae, and a large proportion of them are aggregated in radial pore multiples. The vessel members are shorter with less extensively overlapping, obtuse ends. They usually have simple perforation plates with a single oval or circular opening, but vestigial scalariform perforation plates are of not infrequent

occurrence particularly in close proximity to the metaxylem. The intervascular pitting is dominantly of the alternating multiseriate type, and that between vessels and parenchyma cells exhibits many transitional modifications of the scalariform condition. Furthermore, the vessels are characterized by having conspicuous helical thickenings.

The genus *Xymalos* of the Trimenieae has attained levels of specialization of the xylem which in general closely resemble those of *Hedycarya*. However, the intervascular pitting is predominantly multiseriate.

The other genera of the Trimenieae, *Piptocalyx* (herbarium specimens only) and *Trimenia*, differ from *Xymalos* in having long vessel members with a high percentage of scalariform intervascular pitting, and in retaining a less modified type of ray structure. There are numerous uniseriate rays, in addition to multiseriates, in both the first-formed and the later-formed wood of the stem. Both types of rays are longitudinally extensive when first formed and are composed of upright cells. In subsequently formed wood, the cells of the multiseriate rays — which attain a maximum breadth of only 5–6 cells — vary from upright to isodiametric to procumbent, commonly with a low ratio of procumbent elements.

In contrast to the diversified Hortonieae and Trimenieae, the twelve available genera of the Mollinedieae are all of a fundamentally similar structural type, having xylem which has attained levels of phylogenetic specialization closely comparable to those of different species of *Hedycarya*. The fusiform initials of the cambium and the thin-walled, angular vessel members are relatively long with extensively overlapping ends. The steeply inclined "perforation plates" are scalariform with numerous, vestigially bordered openings. The intervascular pitting, and that between vessels and parenchymatous cells, varies between scalariform and circular multiseriate, the percentages of the different types varying not only from genus to genus and species to species, but also in different vessels of the same plant. Wood parenchyma is greatly reduced in amount and, when present, tends to be scanty paratracheal. The imperforate tracheary elements are septate and commonly have pits which are at a transitional level in the elimination of borders. The uniseriate rays tend to be much reduced in number, but are composed of vertically extensive upright cells. The dominant multiseriate rays of young stems tend to be composed of more or less upright cells, but subsequently exhibit higher percentages of nearly isodiametric and somewhat procumbent ones. The multiseriate rays ultimately become very broad as in *Hedycarya*. The percentage of radial pore multiples varies within the tribe much as it does in different species of *Hedycarya*.

The Monimieae, the fourth tribe of the subfamily Monimioideae, exhibits a much wider range of structural variability, particularly in its vessels. The xylem of *Tambourissa* and *Schrameckia* closely resembles that of the Mollinedieae, whereas the woods of *Hennecartia*, *Monimia* and *Palmeria* illustrate successive phylogenetic changes in the development of simple perforation plates from scalariform ones. In young stems of

Hennecartia omphalandra Poiss. (*Jorgensen 1337*) the scalariform perforation plates have a reduced number of enlarged openings. In comparable material of *Monimia ovalifolia* Thou. (*Blackburn* July 17, 1863) and of *Palmeria coriacea* C. T. White (*Brass 2282*), the perforation plates are transitional between scalariform and simple with a single elongated oval opening. Six other species of *Palmeria* that we have examined possess predominantly simple perforation plates having openings which vary between elongated oval and circular. The vessel members of *Hennecartia, Monimia,* and *Palmeria* are shorter, have less extensively overlapping, and commonly more obtuse, ends. The vessels tend to aggregate in numerous radially oriented pore multiples and the intervascular pitting is predominantly of the alternating multiseriate type. However, the structure of the rays and of the septate fibers, and the distribution of the wood parenchyma are fundamentally similar to those of the Mollinedieae.

In the case of the subfamily Atherospermoideae, the six genera (*Nemuaron, Daphnandra, Laurelia, Atherosperma, Dryadodaphne* and *Doryphora*) of the tribe Laurelieae all form an essentially similar type of xylem. The thin-walled, angular vessel members are long with very extensively overlapping ends and numerous scalariform perforations. The intravascular, as well as the intervascular, imperforate pitting, is predominantly scalariform and transitional. There frequently are numerous intergradations between imperforate bordered pits and perforated ones, illustrating successive stages in the reduction and elimination of borders. Radial pore multiples are of relatively infrequent or sporadic occurrence. Wood parenchyma commonly is absent. The imperforate tracheary tissue is composed of varying admixtures of tracheids, fiber tracheids and septate fiber tracheids. These cells have fairly numerous pits in their tangential, as well as their radial, walls and in their faces of contact with vessels. The first-formed wood of young stems contains, in addition to high-celled uniseriate rays, a varying number of narrow biseriate or triseriate rays whose cells have more nearly equivalent vertical and radial dimensions. During subsequent growth of the stem, there is a precocious transformation of uniseriate rays into multiseriate ones by the division of upright ray initials of the cambium. Thus, there is a high percentage of multiseriate rays — which rarely exceed 5–6 cells in width — with high-celled uniseriate extensions in the outer wood of older stems. The cells of the multiseriate parts of these rays are tangentially slender and extensively procumbent, viz. radially elongated. The percentage of high-celled uniseriate rays varies considerably in different representatives of the tribe.

The large genus *Siparuna* of the tribe Siparuneae is characterized by having abundant wood parenchyma of the diffuse-in-aggregates type. The vessels tend to be larger and less angular than those of the Laurelieae and to occur in pore multiples of varying radial extension. The perforation plates commonly are transitional between scalariform with few bars and simple with a single oval perforation. As is commonly the case in such

transitional forms of perforation plates, reticulate and other aberrant types of structures are of not infrequent occurrence. The intervascular pitting tends to be predominantly of the alternating multiseriate form, and the pitting between vessels and parenchymatous cells exhibits many diversified modifications of the scalariform type. The imperforate tracheary elements vary markedly in density from cells with occluded lumens to others of more nearly normal thick-walled form. The slitlike pits, which may at times have vestigial borders, are of relatively infrequent occurrence except in surfaces that are in contact with parenchymatous cells. Septate fibers are of infrequent occurrence. We have found them in one sample of wood only, a specimen from the Yale collections labeled *Siparuna dentata* (Y-28554). The rays of young stems commonly are a mixture of uniseriates, biseriates and triseriates, but broader rays, 4–6 cells in width, may be formed at times in vigorously growing shoots which have an unusually large pith and wood of low density. All of the rays when first formed tend to be composed of more or less upright cells, those of the uniseriate rays being more conspicuously elongated vertically. During subsequent extension of the rays by cambial activity, they may continue to be composed of upright cells or the multiseriates — which rarely are more than six cells wide except in injured stems — may acquire varying percentages of isodiametric and procumbent cells. In general, the ray cells are much larger and tangentially broader than those of the Laurelieae.

The genus *Bracteanthus* has attained a higher level of structural specialization than have most species of *Siparuna*. The wood parenchyma tends to be of a broad-banded apotracheal and scanty paratracheal type. The vessel members tend to be shorter and to have more obtuse or truncated ends with predominantly simple perforations. The uniseriate rays are much reduced in the wood of older stems and the numerous, relatively narrow multiseriate rays have a low percentage of upright cells.

The African genus *Glossocalyx* differs from the preceding genera of the Siparuneae in having scanty, if any, wood parenchyma, prevailing septate fibers with large lumens, and long thin-walled, angular vessel members with very extensively overlapping ends and numerous scalariform perforations. The intervascular pitting and that between vessels and parenchymatous cells is prevailingly scalariform and transitional. The rays in young stems — no older wood is available — vary from 1–4 cells in width and are composed of upright cells.

STEM-CORTEX, PHLOEM AND PITH

Unfortunately, herbarium specimens and other types of dried material do not provide a satisfactory basis for accurate and detailed investigations of the softer tissues of the cortex and phloem. For such studies, freshly collected and adequately preserved specimens are essential. Therefore, our investigations of the cortex, phloem and pith of the Monimiaceae have been confined largely to a study of the occurrence, and of the structure,

of sclerenchymatous elements in twigs from herbarium specimens. It should be noted in this connection, however, that ethereal oil cells are of common occurrence in the cortex and phloem of monimiaceous genera with the possible exception of *Amborella*. Furthermore, through the kindness of Professor Adriance S. Foster, we have succeeded in obtaining freshly collected shoots of *Peumus Boldus* Mol., *Hedycarya arborea* J. & G. Forst. and *Laurelia Novae-Zelandiae* A. Cunn. preserved in FAA fixative. At least in these species, the secondary phloem differs from that of *Austrobaileya* in forming sieve tubes that are accompanied by companion cells.

The young stems of *Hortonia, Peumus, Hedycarya, Leviera* and *Decarydendron* of the Hortonieae, of *Xymalos* of the Trimenieae, and of the Mollinedieae, Monimieae and Laurelieae are characterized by forming a composite cylinder of sclerenchyma in the so-called pericyclic region. This cylinder is composed of strands of commonly septate fibers (confronting the fascicular parts of the eustele) alternating with strands of hippocrepiform sclereids (confronting the interfascicular parts of the eustele). The vesselless genus *Amborella* is unique among the Monimiaceae in forming a sclerenchymatous cylinder that is composed of hippocrepiform sclereids only, Bailey and Swamy (1). In comparable young stems of *Trimenia, Piptocalyx* and the Siparuneae, there are strands of fibers confronting the fascicular parts of the eustele, but no hippocrepiform sclereids, or only vestiges of such cells, in the intervening parts. Where composite sclerenchymatous cylinders are formed, during subsequent enlargement of the stem, the sclereids tend to have uniformly thickened walls.

Large stone cells, either singly or in more or less massive clusters, occur in the cortex and pith of many species of the Monimiaceae. They may be distributed throughout the stem or they may be confined largely to the nodal regions. Precocious sclerosis of the multiseriate rays of the secondary phloem is of common occurrence in *Hedycarya,* the Mollinedieae and the Monimieae. *Trimenia* and *Piptocalyx* are characterized by the precocious development of much elongated, relatively slender sclereids ("rod cells") in those parts of the secondary phloem that are formed by the fusiform initials of the cambium. The maturation of these sclerenchymatous cells is preceded by one or more transverse divisions of the derivatives of the fusiform initials. Such "rod cells" occur in the older secondary phloem of large stems of *Hedycarya, Siparuna, Monimia* (Hobein 8), *Peumus* (Hobein 8), *Atherosperma* (Möller 11), and in all probability are a characteristic feature of many representatives of the Monimiaceae.

Precocious flaring of multiseriate rays in the phloem, as in the Degeneriaceae, Magnoliaceae and Annonaceae, is of common occurrence in the Monimiaceae, but stratification of the secondary phloem by true phloem fibers does not occur in any of the Monimiaceae that we have studied.

NODAL ANATOMY AND VASCULATURE OF THE LEAF

The nodal anatomy of the Monimiaceae (with the exception of *Scyphos-*

tegia and *Idenburgia* which we are excluding from relationship to the family) is uniformly *unilacunar,* i.e., all of the vasculature of the leaf is related to a single "gap" in the eustele of the stem.

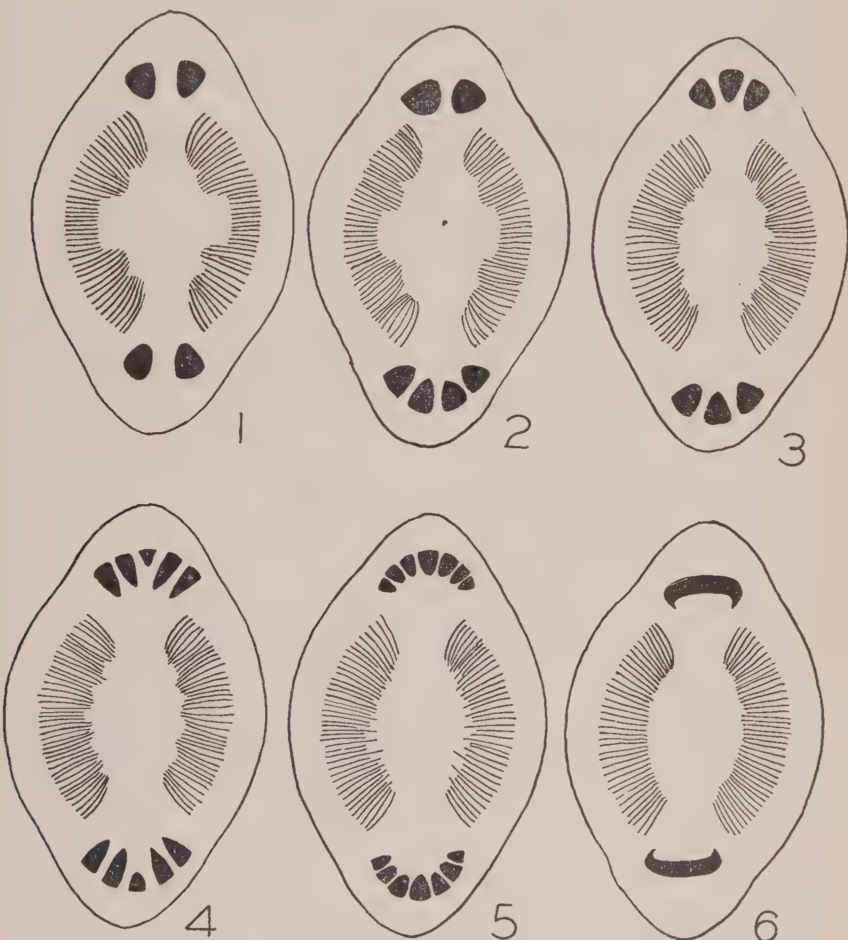
In dealing with nodal anatomy, it is essential to bear in mind that there is in dicotyledons a basic or fundamental pattern of cotyledonary vascularization that is variously modified in different families. Each cotyledon of this basic type is vascularized by two independent traces that are more or less widely separated at the nodal level and are related to a single "gap." These traces bifurcate, forming four vascular strands, the central pair of which tend to fuse and to form the mid-vein of the lamina. In other words, there are transitions in the basal part of the cotyledon between an *even* number of traces and an *odd* number of conspicuous veins. However, the bilateral halves of the cotyledon are vascularized by branches of two vascular strands that are distinct and independent at nodal and subnodal levels.

The decussate, pinnately veined leaves of *Austrobaileya,* as shown by Bailey and Swamy (2), are vascularized by two discrete strands that are related to a single gap in the eustele. The two strands frequently remain separate throughout the petiole and the costa of the lamina, each bilateral half of the leaf being vascularized by the ramifications of an independent system, or the two strands may fuse to form a single mid-vein, particularly in the middle and upper parts of the lamina. Below the node, the two foliar traces remain independent of each other and become attached to two independent parts of the eustele, i.e., the two leaf traces do not originate as a dichotomy of a single vascular bundle.

The nodal anatomy, *Text-fig. 1,* and the vasculature of the leaves, *Text-fig. 7,* of *Trimenia* closely resemble those of *Austrobaileya.* In the related genus *Piptocalyx,* there are two traces at nodal or subnodal levels which bifurcate forming four strands, *Text-fig. 2,* the central pair of which tend to fuse at a higher level, *Text-fig. 8.* At a still higher level, the three resulting strands fuse to form the arc-shaped mid-vein of the lamina, *Text-fig. 8.* The particular levels at which bifurcation and fusion of strands occur vary considerably from leaf to leaf even of the same plant. Thus, the bifurcation of the two traces may be precocious and occur at nodal or even sub-nodal levels.

As previously indicated, *Hortonia, Peumus, Hedycarya, Levieria, Decarydendron, Xymalos,* the Mollinedieae and the Monimieae have relatively wide multiseriate rays in the first-formed secondary xylem. All of these representatives of the Monimiaceae are characterized by having several separate traces at the nodal level, commonly three, five or seven, *Text-figs. 3, 4, 5.* That these strands result from the bifurcation of two independent bundles may be demonstrated by tracing them downward through one or two internodes. In many cases at least, the odd number of traces at the nodal level is due to the fusion of strands that belong to the two independent systems of vasculature. Whether this is invariably the case, or whether transitions from an even to an odd number of strands

may be due at times to asymmetrical bifurcation or to aberrant bifurcations and fusions cannot be determined with certainty without access to more extensive and adequately preserved material. The vascularization patterns of the petiole and lamina of the leaf (as seen in transverse sections) vary considerably in different genera and species, and even at times



TEXT-FIGURES 1–6. Nodal structure as seen in transverse sections. *Fig. 1. Trimenia weinmanniaefolia. Fig. 2. Piptocalyx Moorei. Fig. 3. Hortonia angustifolia. Fig. 4. Anthobembix Brassii. Fig. 5. Mollinedia Rusbyana. Fig. 6. Atherosperma moschatum.*

in leaves of different sizes from the same plant. Frequently, the vascular strands are aggregated, in both the petiole and costa, in the form of a shallow arc, *Text-fig. 9.* The individual strands may remain distinct or they may fuse at varying levels of the petiole or lamina. In the petioles

of *Peumus, Macrotorus,* certain species of *Palmeria* and of *Matthaea, Text-fig. 10,* as of *Piptocalyx, Text-fig. 8,* the complex of vascular tissue tends to assume the form of a cylinder that is open on the adaxial side. In those of *Monimia,* and certain species of *Hortonia* and *Palmeria, Text-fig. 11,* the cylinder may be closed by concrescence of its adaxial margins. In the case of *Anthobembix* and certain species of *Matthaea* and *Steganthera,* parts of the shallow arc become detached on the adaxial side, *Text-fig. 12.*

The tendency toward fusion of vascular strands in the leaf is much intensified in representatives of the Monimiaceae which have relatively narrow rays in the first-formed secondary xylem. In *Amborella,* there is

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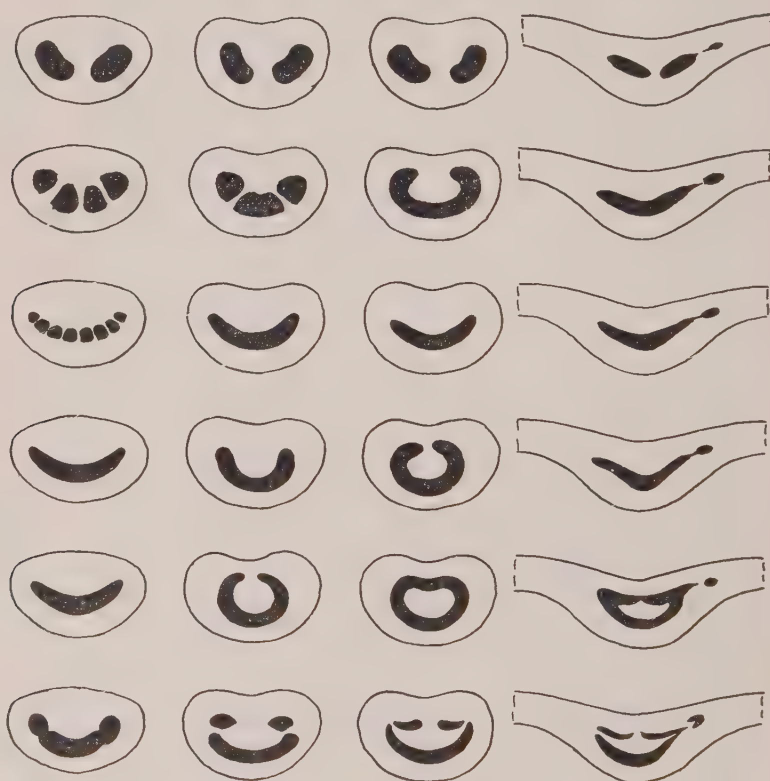


TEXT-FIGURES 7–12. Petiole and base of lamina as seen in successive transverse sections. For further explanation see text.

a single arc-shaped leaf trace at the nodal level which extends outward through the petiole and lamina as a single shallow arc-shaped mid-vein. Similarly, there tends to be a single arc-shaped leaf trace at the nodal levels of the Siparuneae, *Text-fig. 6,* but in this tribe the vascular strand frequently assumes a cylindrical form in the petiole and costa of the leaf,

Text-fig. 11. The Laurelieae are transitional and variable, at times having separate strands at the nodal level and at others a single arc-shaped trace. In the petiole and costa of the leaf, the complex of more or less concrescent strands usually is in the form of a shallow arc.

In the Atherospermoideae, as in *Austrobaileya* and the Monimioideae, the vasculature of the leaf is derived from two systems of vascular strands that are separate and independent at lower levels of the stem.

FLOWERS

As clearly recognized by previous students of the family, there are many diverse trends of morphological specialization in the flowers of the Monimiaceae. The most conspicuous of these are: (1) cupuliform and urceolate modifications of the receptacle, (2) more or less extensive cohesion and adnation within the perianth leading in certain cases to calyptrate structure or to the formation of a velum, (3) a wide range of variability in the form of stamens and staminodes, and (4) transitions between bisexuality and unisexuality.

The Mollinedieae, Monimieae, and Siparuneae are far advanced in floral specialization. It is the Hortonieae, Trimenieae and Laurelieae that exhibit initial and transitional stages of floral modification, and that are particularly significant in discussions of the relationships of the Monimiaceae to other dicotyledonous families.

In the genus *Trimenia,* five putative species of which have been examined by us, the inflorescences are dichasial cymes of varying complexity. The ultimate flower-bearing axis of these inflorescences exhibits no clearly defined differentiation into pedicel and receptacle, *Plate I, Fig. 2.* They are approximately cylindrical with a convex apex upon which the stamens and carpel are borne. They are invested — commonly, but not invariably, clear to their base, *Plate I, Fig. 1* — by from 5–25 pairs of decussately arranged scale-like, overlapping appendages of similar texture and venation. The lowermost of these clasping, deeply concave appendages are relatively short and obtuse (occasionally emarginate) with decurrent bases, the uppermost ones tend to be broadly oblanceolate, and the intervening ones symmetrically elliptical. However, the three forms of scale-like appendages intergrade and there are no morphological boundaries between appendages that might be interpreted as sepals and petals, or between tepals and bracteoles, *Plate I, Figs. 8–19.* Most, if not invariably all, of these appendages become successively deciduous prior to anthesis, leaving the stamens and carpel fully exposed.

Each flower has numerous (7–22) stamens, *Plate I, Fig 2,* and commonly, but not invariably a single carpel. At anthesis, the stamens have a linear-oblong anther and more or less extensive, elongated filaments, *Plate I, Fig. 6.* The four, long, slender sporangia are not conspicuously protuberant, and dehiscence is latrorse or slightly introrse. Each stamen has a single vascular strand which broadens in the projecting apex of the connective. The carpel (occasionally two or none) is either fully developed

and functional at anthesis or is rudimentary and presumably sterile. Carpels of the former kind are barrel-shaped, have a massive, coarsely dissected appearing, sessile stigma, *Plate I, Fig. 3,* and contain a single, pendent, anatropous ovule, *Plate I, Fig. 7; Plate III, Fig. 37.* At anthesis, such carpels have a slender trifurcating dorsal strand and a slender ventral strand with a descending branch which vascularizes the ovule. The four strands terminate in an irregular mass of tracheary tissue that subtends the stigma, *Plate III, Fig. 37.* During development of the fruit, the four principal veins become increasingly massive and extensively branched.

Trimenia is evidently a genus whose flowers exhibit transitions between morphological appearances of bisexuality and unisexuality. In the case of certain collections that have been referred to *T. myricoides* Gilg & Schlecht. or to *T. papuana* Ridl. (*Clemens 2415, 3346, 4513, 7671a, 9403b* and *Brass 11292, 11764, 12628*) a majority of the flowers of an inflorescence have, shortly prior to anthesis, a functional appearing carpel and stamens with well developed thecae, but a varying percentage of the flowers from *Brass 11292* and *Clemens 4513* and *9403b* are devoid of a carpel. In the case of other collections assigned to *T. papuana* (*Brass 10862, 11601*) and to *T. arfakensis* Gibbs (*Kanehira & Hatusima 13450*) the flowers, at comparable stages of development, have normal appearing stamens and a rudimentary carpel consisting of a slender stalk, without a locule and ovule, and terminating in an expanded stigmatic surface, *Plate I, Fig. 4.* The flowers of *T. weinmanniaefolia* Seem. are of two kinds, (a) having a functional carpel and stamens with more or less well developed thecae and (b) having functional stamens and a very short rudimentary carpel which terminates in an expanded stigmatic surface, *Plate I, Fig. 5.* The flowers of *Piptocalyx Moorei* Oliv. in general closely resemble those of *Trimenia,* but the male ones differ, according to Perkins and Gilg (14), in not having even the rudiment of a carpel.

Among flowers of *Trimenia* and *Piptocalyx* that have functional carpels, there is considerable variation in the appearance of the stamens at anthesis. In certain instances the stamens or their pollen obviously are defective and sterile, whereas in other cases the anthers contain fully matured pollen. Whether such pollen is viable and actually functional cannot be determined with certainty by the examination of herbarium specimens.

The flower-bearing axes of the paniculate inflorescences of *Amborella* are clearly differentiated into pedicel and receptacle, and their sterile appendages into spirally arranged bracteoles (0–4) and tepals (5–8). The tepals increase in size in an ascending series, the upper ones being broader with expanded membranaceous margins. The male flowers do not form carpellary structures, and the numerous stamens resemble those of certain species of *Drimys,* being broad microsporophylls with elongated, protuberant, subapical sporangia that are oriented parallel to the long axis of the stamen. Each stamen is vascularized by a single strand that branches more or less profusely in the "connective." The male flowers exhibit incipient perigynous tendencies, viz. slight basal concrescence of tepals

and basal adnation between the outer stamens and the tepals. In the female flowers, the five carpels are borne on the slightly convex center of the receptacle and the sterile stamen (occasionally two) is basally adnate to a subtending tepal. The carpels are obovoid with a much expanded sessile stigma which differs from the capitate ones of *Trimenia* and *Piptocalyx* in having two conspicuous feathery flanges. At anthesis, the carpel is vascularized by a massive pinnately branching dorsal strand which terminates in an inverted spray of vascular elements, and a massive bifurcating ventral strand from one branch of which the vascular supply of the ovule is derived. The single somewhat abnormal appearing, anatropous ovule is attached on the ventral side of the locule by a short, obliquely oriented raphe. The micropyle of the ovule points downward, in contrast to that of the pendent anatropous ovule of *Trimenia, Piptocalyx* and other representatives of the Monimioideae which is directed upward.

Not only do the flower-bearing axes of *Hortonia* exhibit differentiation into pedicel and flattened receptacle, but also the tepals are of two sharply defined types, (a) two decussate pairs of fleshy sepals, and (b) numerous (±20) membranaceous petals. The flowers of *H. angustifolia* Trimen (*Thwaites 1026*) and of *H. floribunda* Wight (*Thwaites 1027* and *Wight 2491*) are hermaphroditic and have numerous apparently functional stamens and carpels. There commonly are from 7–9 fertile stamens attached to the outer rim of the flattened receptacle. These broad and relatively short stamens have markedly protuberant sporangia with longitudinal dehiscence. Associated with them are pairs of broad, fleshy, sterile appendages that are vascularized by branches of a toral bundle, a third branch of which extends upward into the stamen, *Plate II, Figs. 20, 21.* These appendages are commonly referred to as "glands," but they exhibit no evidence of glandular structure and appear to be sterile stamens or staminodes. At times, there is an additional inner whorl of more or less numerous staminodes, each of which has a form and venation, *Plate II, Fig. 22,* which indicates that it represents three reduced connate members of the outer staminal whorl. The numerous, relatively slender carpels taper to a style which terminates in a feathery, conduplicate stigma. At anthesis, the carpels are vascularized by a slender, extensive dorsal strand and by a slender ventral one, a branch of which extends diagonally downward toward the base of the single anatropous ovule, *Plate III, Fig. 33.*

The flowers of the Laurelieae show significant similarities to those of *Hortonia,* particularly in their staminodial appendages. Those of *Nemuaron, Daphnandra, Dryadodaphne,* and *Doryphora* are bisexual, having staminodes in addition to fertile stamens. Those of *Atherosperma,* and commonly also of *Laurelia sempervirens* (Ruiz & Pav.) Tul. and *L. Novae-Zelandiae* A. Cunn., are unisexual, the male flowers having no rudiments of carpels and the female ones staminodes without anthers. The flowers of *Laurelia serrata* Phil. (Buchtien 1272) appear to be of an unstable or transitional type since they may have, in addition to functional carpels, two or more stamens with sporangia that contain fully developed

pollen. The receptacle of the Laurelieae exhibits varying degrees of concavity at anthesis, being flat or only slightly concave in *Nemuaron* and certain species of *Daphnandra* (as in *Hortonia*) and deeply concave or cupuliform in *Doryphora, Dryadodaphne* and the female flowers of *Laurelia* and *Atherosperma.* The tepals may be numerous and sharply differentiated into two decussate pairs of sepals and 7–9 petals, viz. *Daphnandra,* or they may be of uniform size and texture and reduced in number, viz. six in *Doryphora.*

The stamens (which have a prevailingly valvular dehiscence) and the staminodes vary considerably in form and size in different genera and species. The fertile microsporophylls occur in close association with a pair of staminodes, as in *Hortonia.* The associated staminodes may be relatively free (*Atherosperma, Plate II, Fig. 26, Dryadodaphne*), more or less basally connate to the sides of the fertile stamen (*Laurelia, Plate II, Fig. 25, Nemuaron, Doryphora, Plate II, Fig. 29*) or adnate to its abaxial surface (*Daphnandra, Plate II, Fig. 27*). It should be emphasized in this connection, however, that the vascularization of the three associated appendages provides no cogent evidence for interpreting the two sterile members as lobes, stipule-like parts or glandular outgrowths of the fertile microsporophyll. The veins of the staminodes (regardless of the degree of concrescence of the three appendages) usually do not arise as branches of the vascular strand of the fertile stamen, but extend independently and more or less extensively downward into the torus. Although the vascular strands of the staminodes commonly arise as branches of a trifurcating toral bundle, this is not invariably the case. Not infrequently the vascular strand of a staminode arises from an independent part of the vascular system of the receptacle.

In addition to an outer whorl of fertile stamens and associated staminodes, there frequently are more or less numerous internal staminodes, as in *Hortonia.* Particularly in such species as *Doryphora sassafras* (A. Cunn.) Endl, *Plate II, Figs. 29–32,* and *Laurelia serrata* Phil., in passing from the outer staminal appendages to the innermost staminodal ones, there are obvious transitional stages, first in the sterilization of the fertile member of three associated appendages and subsequently in the reduction and elimination of the lateral members. It should be noted in this connection, that in *Doryphora, Plate II, Fig. 31,* as in *Peumus, Plate II, Fig. 23,* the laterally concrescent staminodes tend to lose their vasculature as they are reduced in size.

The carpels of the Laurelieae taper to a more or less extensive style and stigma, *Plate III, Figs. 38, 39,* as in *Hortonia.* They differ markedly, however, in the attachment and orientation of their anatropous ovule. As previously stated, the anatropous ovule of the Monimioideae, with the notable exception of *Amborella,* is pendent from the upper surface of the locule *with its micropyle oriented upward, Plate III, Figs. 33–36, 40, 41.* In contrast, the ovule of the Laurelieae, as of the Siparuneae, is attached to the basal part of the locule (rarely by concrescence of its raphe to the side

of the locule, e.g. *Nemuaron* and *Daphnandra*), *with its micropyle oriented downward, Plate III, Figs. 38, 39.*

The flowers of *Peumus, Hedycarya, Levieria, Decarydendron, Xymalos,* the Mollinedieae, Monimieae and Siparuneae are uniformly unisexual and exhibit varied trends of floral specialization. These phylogenetic trends are so obvious and have been so fully described and illustrated by Perkins and others that they need not be re-described by us. It should be noted, however, that stamens with basally concrescent pairs of staminodes occur in the male flowers of *Peumus, Plate II, Fig. 23,* and *Monimia,* and that the female flowers of the former genus have three-lobed staminodes comparable to a stamen and its associated staminodes of the male flower.

POLLEN

The pollen of the Monimiaceae varies in form from spherical to ellipsoidal to rounded conoidal to ovoid, and in size from a diameter of 10 to 15 microns in certain representatives of the Mollinedieae to between 40 and 50 microns in *Peumus* and in some of the Laurelieae. The arrangement of the four grains in the pollen mother cells evidently varies from tetragonal to tetrahedral. Thus, in the case of *Hedycarya angustifolia* A. Cunn. (C. T. White 3584), where the pollen is released in coherent tetrads, *Plate IV, Fig. 53,* the majority of the tetrads are of the tetragonal type, but transitions to a tetrahedral arrangement are of not uncommon occurrence.

Not only does the pollen of the Monimiaceae vary more or less in form and size from genus to genus and from species to species, but also not infrequently within a single anther. It should be emphasized in this connection, however, that, in dealing with dry pollen from herbarium specimens, certain of the deviations in form and size may be due to inequalities of re-expansion of pollen grains in their preparation for microscopic study. Particularly in the case of pollen having a tenuous or unevenly thickened exine, the exact form and size of the grains frequently can be determined only by examining freshly collected pollen (at anthesis) in an isotonic medium.

The pollen of *Austrobaileya* is approximately spherical when fully re-expanded, has a diameter somewhat in excess of 50 microns and is typically monocolpate. The exine is relatively thick, appearing granular at outer and inner focal levels and finely pitted-reticulate at intermediate ones, and thus resembles that of *Zygogynum* of the Winteraceae. The furrow is sharply defined, relatively broad and extensive, *Text-fig. 13,* covering an arc of approximately 180 degrees. The floor of the furrow is tenuous and sparsely granular, Bailey and Swamy (2).

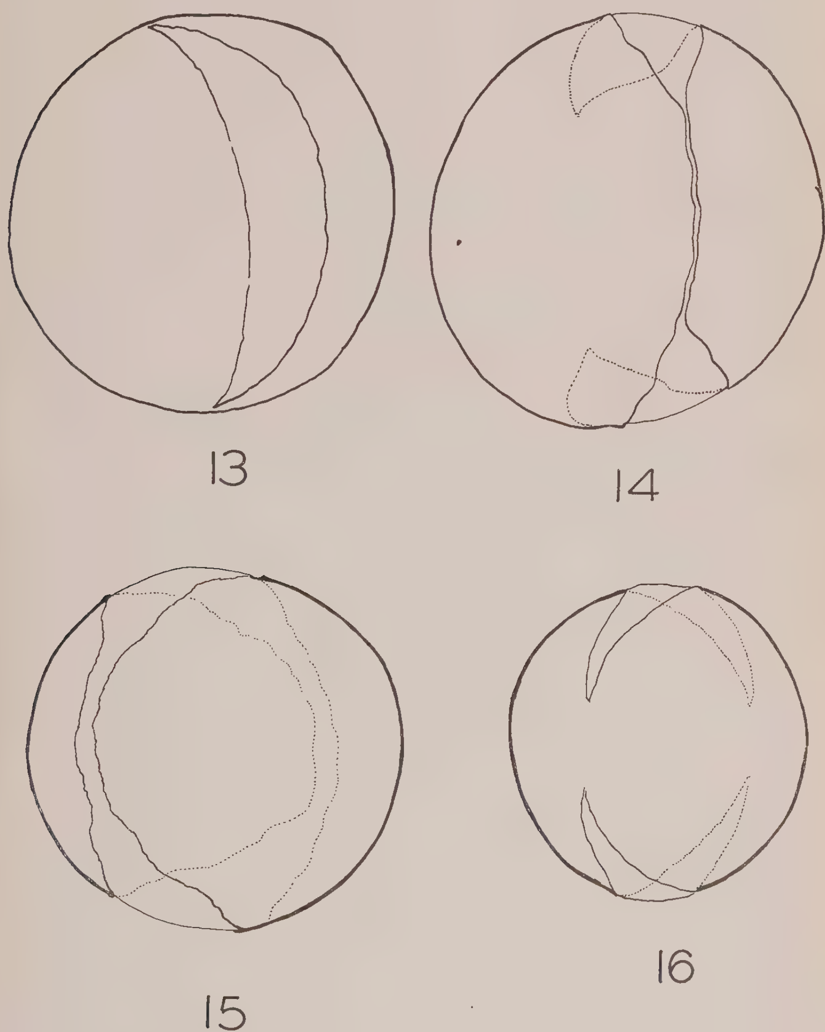
The pollen of the Laurelieae resembles that of *Austrobaileya* in its relatively large size, and in the finely pitted-reticulate and often internally granular character of its exine. It differs, however, in exhibiting structural features that may possibly be interpreted as transitional between monocolpate and dicolpate.

The pollen of *Daphnandra micrantha* (Tul.) Benth. (Saunders 1923), of *Laurelia Novae-Zelandiae* A. Cunn. (Kirk), *Plate IV, Fig. 42,* and of *L. sempervirens* (Ruiz & Pav.) Tul. (J. Gay 1875) — when fully, but not excessively re-expanded — is spherical or somewhat ellipsoidal, and commonly is provided with a furrow which completely encircles each pollen grain. The furrow varies more or less markedly in breadth, being wider in two opposite arcs of its circumferential extension and narrower in its intervening arcs. The floor of the furrow tends to be compactly granular (not reticulate) where it is narrowest and diffusely or sparsely granular where it is broadest. The pollen of *Doryphora sassafras* (A. Cunn.) Endl. (Rodway 825), *Plate IV, Fig. 43,* and of *Atherosperma moschatum* Labill. (Atkinson 100) differs from that of these two species of the Laurelieae in being dominantly dicolpate. The tapered ends of the two broad furrows are separated by more or less extensive pitted-reticulate parts of the exine, the floor of the furrows being sparsely granular. It should be noted in this connection, however, that there is a considerable range of variability in the furrows of the four species of the Laurelieae, certain pollen grains of the former species approximating a dicolpate condition and some from the latter species having such extensive furrows that their tapered ends nearly meet.

The conspicuously ellipsoidal pollen of *Piptocalyx Moorei* Oliv. (C. T. White 7502), *Plate IV, Fig. 44,* has a pitted-reticulate exine, but differs from that of the Laurelieae in its much smaller size and in the restriction and irregularity of its germinal areas, the floor of which is coarsely and irregularly granular.

That the pollen of *Austrobaileya, Text-Fig. 13,* and of the Laurelieae may possibly represent a transitional series between a primitive monocolpate and a derived dicolpate condition is suggested by the pollen of the Magnoliaceae and of the related Degeneriaceae. The Magnoliaceae have a relatively broad furrow on the distal face (Canright 5) of the pollen grains ,as in many seed ferns, Bennettitales, Cycadales, Ginkgoales and monocotyledons. In the Degeneriaceae, the furrow, which is of distal origin (Swamy 18), is extended around the sides of the pollen toward the proximal pole, *Text-fig. 14.* The furrow is much constricted in the vicinity of the distal pole and broadens markedly on the lateral surfaces of the pollen. Additional construction and elimination of the distal part of the furrow would yield a dicolpate condition, *Text-fig. 16.* Further extension of the furrow until its tapered ends meet at the proximal pole would form an alternately constricted and expanded groove which completely encircled the pollen as in *Daphnandra micrantha* and *Laurelia Novae-Zelandiae, Text-fig. 15.* According to such an interpretation, the encircling furrow would be on a meridian as in *Degeneria,* and fundamentally different from the encircling furrows of certain Nymphaeaceae, where, as shown by the coherent tetrads of *Victoria,* the grooves are zonal and are oriented at right angles to the polar axis. It is in the pollen of *Nymphaea, Euryale* and *Victoria* that the thickened distal face of the

grains is interpreted as an operculum (Wodehouse 20). In the case of the Laurelieae, the orientation of the furrows in relation to the polar axis and to the distal and proximal surfaces of the pollen should be studied by someone having access to living flowering representatives of the tribe.



TEXT-FIGURES 13–16. Pollen. *Fig. 13. Austrobaileya. Fig. 14. Degeneria. Fig. 15. Laurelia. Fig. 16. Doryphora.*

Seven additional types of pollen occur in the Monimiaceae, which differ from that of the Laurelieae and *Piptocalyx* in not having a typically pitted-reticulate exine.

The pollen of *Amborella tricopoda* Baill. commonly is of more or less rounded-conoidal form and has maximal dimensions of from 20–27 microns. Pollen from flower buds of Veillard 32 (Paris) is conspicuously and compactly granular and a large proportion of the grains are acolpate. This is in contrast to pollen from open flowers of Viellard 3149 (Kew) which has a thinner, faintly granular exine and an unthickened germinal area on its more acutely curved side. The germinal area varies markedly in size and form and has a very irregular boundary which is delimited by coarser granulation. The conoidal form of the pollen and the irregular shape of the germinal area suggest that the unthickened part of the pollen grain may possibly be on the proximal surface, as in many of the Annonaceae, rather than on the distal surface as in primitively monocolpate pollen.

Trimenia arfakensis Gibbs, *T. myricoides* Gilg and Schlecht., *T. papuana* Ridl. and *T. weinmanniaefolia* Seem., *Plate IV, Fig. 52,* have spherical, polyporate pollen grains that vary in diameter from 22–32 microns. The exine is faintly and compactly granular, and the more or less numerous, irregular germinal areas are detectable in surface view by their coarser and sparser granulation. The pollen of one collection of *T. myricoides,* viz. Clemens 4513, has a uniformly and compactly granular exine and appears to be acolpate. The flowers of this specimen have been parasitized by insects and appear to be abnormal.

Hedycarya-3*, *Levieria*-1, *Decarydendron*-1, *Xymalos*-1, *Ephippiandra*-1, *Steganthera*-1, *Anthobcmbix*-1, *Tetrasynandra*-1, *Wilkiea*-1, *Kibara*-2, *Palmeria*-5, *Hennecartia*-1, *Bracteanthus*-1, and *Siparuna*-22 have spherical, acolpate pollen with a granular exine as seen in surface view. The grains vary in diameter from less than 15 microns in *Anthobembix* to more than 35 microns in *Decarydendron, Xymalos,* and *Hennecartia.* The granulations of the exine vary from sparse and diffuse to compact and closely crowded. They may be evenly and uniformly distributed or aggregated in irregular groupings. They may be low and faintly visible or coarse, more or less rod-like or even slightly echinate, e.g. *Palmeria, Plate IV, Fig. 50.*

The large, spherical, acolpate pollen of *Peumus, Plate IV, Fig. 54,* and *Monimia* differ from this type of monimiaceous pollen in having large, coarse, diffusely distributed spines on their faintly granular surface.

The pollen of *Mollinedia*-9 and *Macrotorus*-1 varies in form from rounded conoidal to ellipsoidal, rarely having a maximal diameter of more than 30 microns and a minimal one of less than 20 microns. At lower magnifications, the grains resemble those of certain of the Nymphaeaceae, appearing to have a subpolar encircling furrow and a broad circular or oval operculum, *Plate IV, Fig. 51.* However, at high magnification, the floor of the putative furrow proves to be as thick as, if not actually somewhat thicker than, the rest of the exine. It is clear and homogeneous and exhibits no granulations or minute pits such as are visible in other parts of the exine. Nor does the sculpture of the putative operculum differ from

* Number of species examined.

that of the exine on the opposite side of the pollen. Thus, the pollen of *Mollinedia* and *Macrotorus* are essentially acolpate, having no true germinal groove or furrow. *Macropeplus*-1 forms a similar type of pollen as regards size, form and sculpture of the exine, except that the homogeneous bands are discontinuous and commonly do not completely encircle the grains.

The acolpate, nearly spherical (20–33 microns in diameter) pollen of *Tambourissa*-1, *Plate IV, Figs. 46, 47,* and *Schrameckia*-1, *Plate IV, Fig. 45,* has a finely ridged and grooved exine. The sculptural patterns of the exine vary considerably, grading at times into pitted or granular forms.

The most distinctive and remarkable acolpate pollen is that of *Hortonia*-2, *Plate IV, Figs. 48, 49.* The grains vary markedly in size and form, the variations being due, at least in part, to inequalities of re-expansion. The exine is composed of a varying number of coarse, hemi-helical bands, extending from one "pole" to the opposite one. The bands are sharply curved or folded as seen in optical section and are finely granular in surface view.

DISCUSSION AND CONCLUSIONS

As stated earlier in this paper, a summation of anatomical and morphological evidence indicates that *Idenburgia* and *Scyphostegia* do not belong in the Monimiaceae or related families. The Monimiaceae, Gomortegaceae, Lauraceae and Hernandiaceae are characterized by having ethereal oil cells and a unilacunar nodal anatomy. *Idenburgia* and *Scyphostegia* have a typically trilacunar nodal structure and no ethereal oil cells. The leaves of *I. elaeocarpoides* Gilg & Schlecht. contain numerous large styloids, those of *S. borneensis* Stapf very abundant, large druses, types of crystals that are alien to the Monimiaceae and its allies. The pollen of *Scyphostegia* is tricolpate which excludes the genus from relationship to most woody ranalian families. That of *Idenburgia* is acolpate, but it is morphologically unlike the pollen, not only of the Trimenieae, but also of the other tribes of the Monimiaceae.

The 35 remaining genera of the Monimiaceae that we have studied fall into a number of more or less natural categories. The Monimioideae of Perkins and Gilg (15), with the inclusion of *Decarydendron, Hedycaryopsis* and *Schrameckia,* and the exclusion of *Hortonia, Amborella, Trimenia* and *Piptocalyx,* constitutes the largest subfamily of relatively closely related genera. It is characterized by having unisexual flowers, a pendant anatropous ovule with the micropyle oriented upward, a composite sclerenchymatous cylinder composed of fibers and hippocrepiform sclereids in the "pericyclic" region of the stem, relatively broad rays in both the first-formed and the later-formed secondary xylem, scanty wood parenchyma, septate fibers, acolpate pollen, and unilacunar nodes with three or more separate traces to each leaf.

In contrasts, the Atherospermoideae of Perkins and Gilg is a less natural subfamily, being held together, and differentiated from the

Monimioideae, by the valvular dehiscence of the stamens, the orientation of the anatropous ovule with the micropyle directed downward, the relatively narrow rays, and a tendency to form single arc-shaped leaf traces at the nodal level. However, the tribes Laurelieae and Siparuneae of the Atherospermoideae differ markedly in both their reproductive and their vegetative parts. The flowers of the Laurelieae (*Nemuaron, Daphnandra, Dryadodaphne, Doryphora, Laurelia* and *Atherosperma*), with their obvious transitions between bisexuality and unisexuality, their highly characteristic staminodes, and their large, reticulate, monocolpate and dicolpate pollen, are fundamentally unlike the prevailingly unisexual flowers of the Siparuneae (*Siparuna, Bracteanthus, Glossocalyx*) with their pronounced tendency toward the development of a velum and their granular acolpate pollen. Similarly, the stems of the Laurelieae, with their hippocrepiform sclereids, primitive vessel structure, reduction of wood parenchyma and transitions between tracheids and septate fibers are significantly unlike the stems of *Siparuna* and *Bracteanthus,* which lack hippocrepiform sclereids and septate fibers, have abundant wood parenchyma, relatively highly specialized vessel structure, and imperforate tracheary cells that are at a transitional level between fiber tracheids and libriform fibers.

Although the flowers of *Glossocalyx* resemble those of the Siparuneae, its combination of anatomical characters is unlike that of either the Laurelieae or the Siparuneae. The stems resemble those of the Laurelieae in their primitive vessel structure and their reduction of wood parenchyma, but differ from them in the absence of hippocrepiform sclereids and in having a higher level of replacement of tracheids and fiber tracheids by septate fibers.

Before attempting to determine whether the Atherospermoideae of Perkins and Gilg should be retained as a subfamily coordinate with the Monimioideae, it is essential to discuss *Hortonia, Amborella, Trimenia* and *Piptocalyx,* and to view the Monimiaceae in their entirety.

As the genus *Sarcandra* of the Chloranthaceae so clearly demonstrates, Swamy and Bailey (19), the occurrence of vesselless xylem, by itself, is inadequate evidence for excluding a genus from a ranalian family. Therefore, *Amborella* should not be removed from the Monimiaceae solely upon the basis of its vesselless structure. Other morphological and anatomical evidence should be taken into consideration and evaluated. The spiral, rather than basically decussate, arrangement of leaves, bracteoles, and tepals, the form and vascularization of the carpels, the morphology of the fruit, the insignificance (if not actual absence) of ethereal oil cells, the occurrence of multicellular hairs, and the absence of fibers in the "pericyclic" region of the stem, are characteristics of *Amborella* that are alien to the Monimiaceae as a whole. Furthermore, the orientation of the anatropous ovule with its micropyle directed downward, the relatively narrow rays and the single arc-shaped leaf trace make *Amborella* a discordant and unnatural representative of the Monimioideae. The nor-

mal, rather than valvular, dehiscence of its stamens excludes it from the Atherospermoideae. It is in its hippocrepiform sclereids and pollen that *Amborella* exhibits significant evidence of relationship to the Monimiaceae. Thus, a summation of morphological and anatomical evidence suggests that *Amborella* should be placed in an independent family closely related to the Monimiaceae.

Similarly, the totality of evidence from the floral and vegetative parts of *Trimenia* and *Piptocalyx* indicates that these genera likewise should be placed in an independent family, but one having evident relationships, not only to the Monimiaceae and Lauraceae, but also to *Austrobaileya* and the Chloranthaceae. The floral axis without conspicuous differentiation into pedicel and receptacle, and the intergrading bracteoles and tepals of similar texture and venation (that are deciduous prior to anthesis) place these genera in a category by themselves. Furthermore, the absence of even incipient broadening or concavity of the apex of the floral axis, the absence of initial cohesion or adnation of floral parts, the absence of hippocrepiform sclereids, together with the presence of mucilage cells (as Lauraceae) of polyporate pollen (as certain Chloranthaceae) and of a distinctive type of nodal anatomy (as *Austrobaileya* and *Chloranthaceae*) provide additional evidence for excluding *Trimenia* and *Piptocalyx* from the Monimiaceae proper. It should be noted in this connection that the similarity between the carpels of these genera and that of *Xymalos* is superficial. The structure of the stigmas and the vascularization of the carpels is fundamentally different.

In contrast to *Amborella, Trimenia* and *Piptocalyx, Hortonia* has a complex of characters indicative of a much closer relationship to the Monimiaceae. It resembles the Monimioideae in the orientation of its ovule, in the non-valvular dehiscence of its stamens, in its nodal anatomy and in its sclerenchymatous cylinder composed of both fibers and hippocrepiform sclereids; the Laurelieae, in its bisexual flowers, in its staminodial structures, its relatively narrow rays and its retention of primitive imperforate tracheary elements, the Siparuneae (*Siparuna* and *Bracteanthus*), in its abundant apotracheal wood parenchyma and in the absence of septate fibers. In one character only, viz. its pollen, does it differ markedly from all other investigated genera of the Monimiaceae. Thus, a summation of morphological data indicates that the genus should be kept in the Monimiaceae and placed in a separate subfamily.

With the exclusion of *Amborella, Trimenia* and *Piptocalyx,* as formerly of *Calycanthus* and *Gomortega,* the Monimiaceae becomes a relatively natural family, but one which exhibits diverse trends of floral and vegetative modification from an ancestral stock of which *Hortonia* appears to be the least specialized surviving representative. In other words, although exhibiting precocious modification of its pollen, its intervascular pitting and to a certain extent in its rays, *Hortonia* appears in general to have retained a relatively primitive combination of floral and vegetative characters, and therefore affords valuable clues in studying and in

interpreting the major trends of phylogenetic specialization within the Monimiaceae.

Utilizing *Hortonia* as a basis of comparison, it is evident that the flowers of the Laurelieae — in acquiring valvular dehiscence of their stamens and a modified orientation of their anatropous ovule — have retained relatively conspicious free tepals; stamens with associated pairs of staminodes, which in turn may be variously modified in form and which may at times assume a glandular function; numerous transitions between bisexuality and unisexuality; and varied stages of increasing concavity and extension of the receptacle, particularly subsequent to anthesis. It should be emphasized in this connection that it is the stamens and associated staminodes of *Hortonia* and the Laurelieae — with concomitant valvular dehiscence in the Laurelieae — that provide the most cogent evidence of relationship between the Monimiaceae, and the Gomortegaceae, Lauraceae and Hernandiaceae. The stems of the Laurelieae, while retaining relatively primitive vessels and tracheids, have deviated from those of *Hortonia* in reduction of wood parenchyma and concomitant development of septate fibers. Furthermore, the reduction in width of multiseriate rays — detectable in the internodal parts of young stems of *Hortonia* — has progressed much farther in the Laurelieae. Associated with this narrowing of rays are tendencies toward formation of a single arc-shaped leaf trace at the nodal level and toward lessened development of hippocrepiform sclereids.

The Siparuneae, although resembling the Laurelieae in valvular dehiscence, orientation of the anatropous ovule, narrowing of multiseriate rays and nodal anatomy, exhibit such divergent trends of floral specialization as to inhibit a direct derivation of one tribe from the other. On the contrary, a summation of evidence is indicative of independent and, in certain characters, parallel development of both groups of plants from common ancestors of a hortonia-like type. The prevailing unisexual flowers of the Siparuneae in many respects more closely resemble those of the Monimioideae than those of the Laurelieae. The flowers of the Monimioideae (with the exception of *Peumus* and *Monimia*), as of the Siparuneae, have lost all vestiges of stamens with associated pairs of staminodes. Furthermore, there are essentially similar reduction, cohesion and adnation of tepals associated with progressive cupuliform and urceolate modifications of the receptacle. In addition, both groups of plants are characterized by having granular acolpate pollen in contrast to the more primitive monocolpate or dicolpate pollen of the Laurelieae. However, the trends of phylogenetic specialization in the stems of the Monimioideae negate any possibility of direct derivation of the Siparuneae from the Monimioideae, and are indicative rather of independent and partly parallel development from common ancestors.

In view of such facts as these, based upon the study and evaluation of summations of morphological and anatomical data, it seems advisable to revise Perkins' and Gilg's classification of the Monimiaceae as follows:

Amborellaceae (Pichon 16)

Floral axis differentiated into pedicel and receptacle, bearing spirally arranged bracteoles and tepals of progressively increasing size. *Flowers* unisexual, ♀ with one or two sterile stamens. *Stamens* of male flower numerous without associated staminodes, the outer ones basally adnate to subtending tepals. *Pollen* granular acolpate or with single, irregular, unthickened area. *Carpels* 5, free, attached to the slightly convex apex of the receptacle, obovoid with sessile stigma having two expansive feathery flanges, complex vascularization, and a single anatropous ovule, the micropyle oriented downward. *Fruit* stipitate, conspicuously pitted-reticulate when dry with vestiges of stigmatic crests subterminal. *Ethereal oil cells* inconspicuous or absent (?). *Mucilage cells* absent. *Leaves* alternate at unilacular nodes, leaf trace arc-shaped at nodal level. *Stem* hippocrepiform sclereids present, xylem vesselless. *Amborella.*

Trimeniaceae (Gibbs 7)

Floral axis not differentiated into pedicel and receptacle, bearing decussate bracteoles and tepals of similar texture and venation, intergrading in form and deciduous prior to anthesis. *Flowers* transitional from bisexual to unisexual. *Stamens* numerous, fertile or sterile, without associated staminodes. *Pollen* polyporate or with two irregular unthickened areas. *Carpel* single (occasionally 2), fertile or sterile, the former barrel-shaped, fluted, bearing a massive, coarsely dissected, sessile stigma and containing a single anatropous ovule with the micropyle directed upward. *Fruit* of magnified carpellary form. *Ethereal oil cells* and *mucilage cells* conspicuously developed. *Leaves* decussate (occasionally subopposite), at unilacunar nodes, two separate traces at nodal or subnodal levels. *Stem* without hippocrepiform sclereids, vessels and rays of primitive form, wood parenchyma reduced and replaced by septate fibers. *Trimenia, Piptocalyx.*

Monimiaceae

Receptacle more or less deeply concave, cupuliform or urceolate. *Flowers* bisexual, unisexual or transitional. *Tepals* variable in size, form, number, adnation and cohesion, fundamentally decussate with transitions to cyclic. *Stamens* usually numerous, free, with normal or valvular dehiscence, with or without associated staminodes. *Pollen* monocolpate, dicolpate or acolpate. *Carpels* usually numerous (except *Xymalos*), free or imbedded in receptacle, with simplified vascularization and a single anatropous ovule which is oriented with its micropyle directed either upward or downward. *Ethereal oil cells* conspicuously present. *Mucilage cells* absent. *Leaves* decussate (occasionally modified during ontogeny to subopposite or whorled, alternate in *Glossocalyx* by suppression of one leaf of each pair or its replacement by a tendril) at unilacunar nodes, with three or more separate traces or a single arc-shaped trace to each leaf. *Stem* hippocrepiform sclereids present or absent, xylem exhibiting diverse trends of structural specialization.

SUBFAMILY — Hortonioideae

Receptacle with incipient, shallow concavity only. *Flowers* bisexual. *Inner tepals* numerous (20±), relatively large, membranaceous and petal-like. *Stamens* with non-valvular dehiscence and associated pairs of staminodes. *Pollen* acolpate with hemi-helical thickenings. *Carpels* having pendent ovule with the micropyle directed upward. *Leaves* with three or more separate traces at the unilacunar nodes. *Stem* hippocrepiform sclereids present in the "pericyclic" region, vessels and imperforate tracheary elements of primitive form, wood parenchyma abundant, septate fibers absent, multiseriate rays of young stems relatively narrow. *Hortonia.*

SUBFAMILY — Atherospermoideae

Receptacle more or less deeply concave, cupuliform or urceolate, particularly subsequent to anthesis. *Flowers* bisexual, unisexual or transitional. *Stamens* with valvular dehiscence and associated pairs of staminodes. *Pollen* monocolpate or dicolpate. *Carpels* having ovule with the micropyle directed downward. *Leaves* tending to have arc-shaped trace at nodal level. *Stem* hippocrepiform sclereids present, abundant or scanty, vessels of primitive form, transitions between tracheids and septate fibers, wood parenchyma scanty or absent, rays relatively narrow. *Nemuaron, Daphnandra, Dryadodaphne, Doryphora, Laurelia, Atherosperma.*

SUBFAMILY — Monimioideae

Receptacle more or less expansive, cupuliform or urceolate. *Flowers* unisexual. *Tepals* more or less reduced in size and number with varying degrees of basal concrescence and adnation. *Stamens* with non-valvular dehiscence and without associated staminodes (except *Peumus* and *Monimia*). *Pollen* acolpate. *Carpels* having ovule with the micropyle oriented upward. *Leaves* having three or more separate traces at the unilacunar nodes. *Stem* hippocrepiform sclereids present, vessels primitive scalariform or transitional to porous (*Peumus, Monimia, Palmeria, Hennecartia*), woody parenchyma scanty and replaced by septate fibers, rays relatively wide. *Hedycarya, Levieria, Decarydendron, Kibaropsis* (?), *Xymalos, Macropeplus, Mollinedia, Macrotorus, Matthaea, Ephippiandra, Steganthera, Anthobembix, Tetrasynandra, Wilkiea, Kibara, Carnegieodoxa, Lauterbachia, Hedycariopsis, Palmeria, Canaca, Tambourissa, Monimia, Peumus, Hennecartia, Schrameckia.*

SUBFAMILY — Siparunoideae

Receptacle urceolate. *Flowers* unisexual with strong tendency toward the formation of a velum. *Stamens* with valvular dehiscence and without associate staminodes. *Pollen* granular acolpate. *Carpels* free, imbedded in receptacle or with concrescence of styles, micropyle of the anatropous ovule oriented downward. *Leaves* tending to have a single arc-shaped trace at the unilacunar node. *Stem* hippocrepiform sclereids absent, rays

relatively narrow, abundant apotracheal parenchyma (except *Glossocalyx*). *Siparuna, Bracteanthus, Glossocalyx.*

It should be noted, in connection with our suggested revision of the Monimiaceae, that the receptacle of *Xymalos* lacks evidence of even incipient concavity, the apex of the floral axis being convex in the male flower and flattened in the unicarpellate female flower. However, a summation of other morphological and anatomical data indicates that the genus belongs in the florally variable subfamily Monimioideae. The genus *Peumus* resembles *Monimia* in its stamens with pairs of closely associated staminodes, in its large, spiny, acolpate pollen, and in its specialized, viz. porous, vessel structure. Therefore, it has been included in the Monimioideae.

As recognized by Wodehouse (20, '21), there are two fundamentally different forms of pollen morphology that are of salient evolutionary significance in the study of seed-bearing plants. Most of the orders and families of the dicotyledons are characterized by having tricolpate pollen or forms of pollen that have been derived phylogenetically from such tricolpate grains. Tricolpate pollen is not known to occur in any other group of seed-bearing plants, and therefore is indicative of a distinctive trend of specialization in dicotyledons. Distally monocolpate pollen, which is so characteristic of many seed ferns, Bennettitales, Cycadales and Ginkgoales, is of not infrequent occurrence in monocotyledons, but is confined in the dicotyledons to certain families of the Ranales (*sensu lato*). Among these families, there is evidence of the phylogenetic modification of distally monocolpate pollen to proximally monocolpate, dicolpate, polyporate, and acolpate forms, just as among other families of the dicotyledons, there are obvious transitions between tricolpate pollen and polycolpate, polyporate and acolpate ones. Although the end-products of specialization (viz. polyporate and acolpate) of monocolpate and tricolpate pollen may at times be somewhat similar, they arise by entirely different phylogenetic modifications.

Ranalian families with monocolpate pollen, and phylogenetically modified forms of such pollen, are characterized by having ethereal oil cells. Among these dicotyledons there are two distinct categories of families, (a) having unilacunar nodes, and (b) with trilacunar or multilacunar nodes, as follows:

MONOCOLPATE AND DERIVED DICOLPATE, POLYPORATE AND ACOLPATE POLLEN–ETHEREAL OIL CELLS PRESENT

A. Nodes Unilacunar

Austrobaileyaceae	Lauraceae
Trimeniaceae	Hernandiaceae
Amborellaceae	Chloranthaceae
Monimiaceae	Calycanthaceae
Gomortegaceae	Lactoridaceae

B. Nodes Trilacunar or Multilacunar

Winteraceae	Myristicaceae
Degeneriaceae	Eupomatiaceae
Himantandraceae	Canellaceae
Magnoliaceae	Piperaceae
Annonaceae	Saururaceae

A summation of cumulative morphological and anatomical data indicates that the first seven families in category A are more or less closely related, and therefore form a natural grouping. Evidence for and against including the Chloranthaceae, Calycanthaceae and Lactoridaceae in this group of related families (as for including the Piperaceae and Saururaceae in category B) will be dealt with in subsequent papers.

It should be emphasized, in conclusion, that it is not possible to arrange the families of categories A and B in linear phylogenetic series, viz. deriving one family directly from a preceding one. When the totality of evidence from all parts of the plants is taken into consideration, it becomes apparent that each family exhibits one or more independent trends of specialization that negate such a possibility. The two categories comprise more or less closely related families that have been derived from common ancestors. Such ancestors, until found in the geological record, can be synthesized only by combining the more primitive features of a number of different surviving families.

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EXPLANATION OF PLATES

PLATE I. *Fig. 1. Trimenia myricoides.* (Clemens 3346), part of inflorescence. *Fig. 2. The same,* floral axis showing stamens after the removal of "perianth." *Fig. 3. The same,* carpel. *Fig. 4. T. papuana* (Brass 10862), sterile carpel. *Fig: 5. T. weinmanniaefolia* (A. C. Sm. 1888), sterile carpel. *Fig. 6. T. myricoides,* stamen after anthesis. *Fig. 7. T. myricoides* (Clemens 4513), longitudinal section of a fruit showing attachment of the seed. *Figs. 8–19. T. myricoides* (Clemens 3346), bracteoles and tepals arranged in an ascending series.

PLATE II. Stamens and staminodes. *Fig. 20. Hortonia floribunda* (Wight 2491), fertile stamen and pair of associated staminodes. *Fig. 21. The same,* lateral view. *Fig. 22. The same,* inner compound staminode. *Fig. 23. Peumus Boldus* (Werdermann 311), fertile stamen with associated staminodes. *Fig. 24. The same,* simple staminode. *Fig. 25. Laurelia Novae-Zelandiae* (Kirk), fertile stamen and associated staminodes. *Fig. 26. Atherosperma moschatum* (Gunn), fertile stamen and associated staminodes. *Fig. 27. Daphnandra micrantha* (Saunders 1923), fertile stamen and associated staminodes. *Fig. 28. The same,* simple staminode. *Fig. 29. Doryphora sassafras* (Rodway 825), fertile stamen and associated staminodes. *Fig. 30. The same,* inner compound staminode. *Fig. 31. The same,* reduction of lateral members of compound staminode. *Fig. 32. The same,* inner simple staminode.

PLATE III. Form and vasculature of carpels. *Fig. 33. Hortonia floribunda* (Wight 2491). *Fig. 34. Hedycarya dorstenioides* (Degener 14596). *Fig. 35. Xymalos myrtoides* (Humbert 3447). *Fig. 36. Levieria acuminata* (Kajewski 1439). *Fig. 37. Trimenia papuana* (Brass 11292). *Fig. 38. Laurelia sempervirens* (Gay 1875). *Fig. 39. Atherosperma moschatum* (de Beuzeville 209a). *Fig. 40. Peumus Boldus* (Foster). *Fig. 41. Kibara serrulata* (Scortechini 1307).

PLATE IV. Pollen × 900. *Fig. 42. Laurelia Novae-Zelandiae* (Kirk). *Fig. 43. Doryphora sassafras* (Rodway 825). *Fig. 44. Piptocalyx Moorei* (C. T. White 7502). *Fig. 45. Schrameckia madagascariensis* (Dangue 134). *Fig. 46. Tambourissa quadrifolia* (Vaughan 544), "polar" view. *Fig. 47. The same,* lateral view. *Fig. 48. Hortonia floribunda* (Thwaites 1027), "polar" view. *Fig. 49. The same,* lateral view. *Fig. 50. Palmeria scandens* (Maiden 375). *Fig. 51. Mollinedia discrepans* (Skutch 2609). *Fig. 52. Trimenia weinmanniaefolia* (A. C. Sm. 1888). *Fig. 53. Hedycarya angustifolia* (C. T. White 3584). *Fig. 54. Peumus Boldus* (Castillo).

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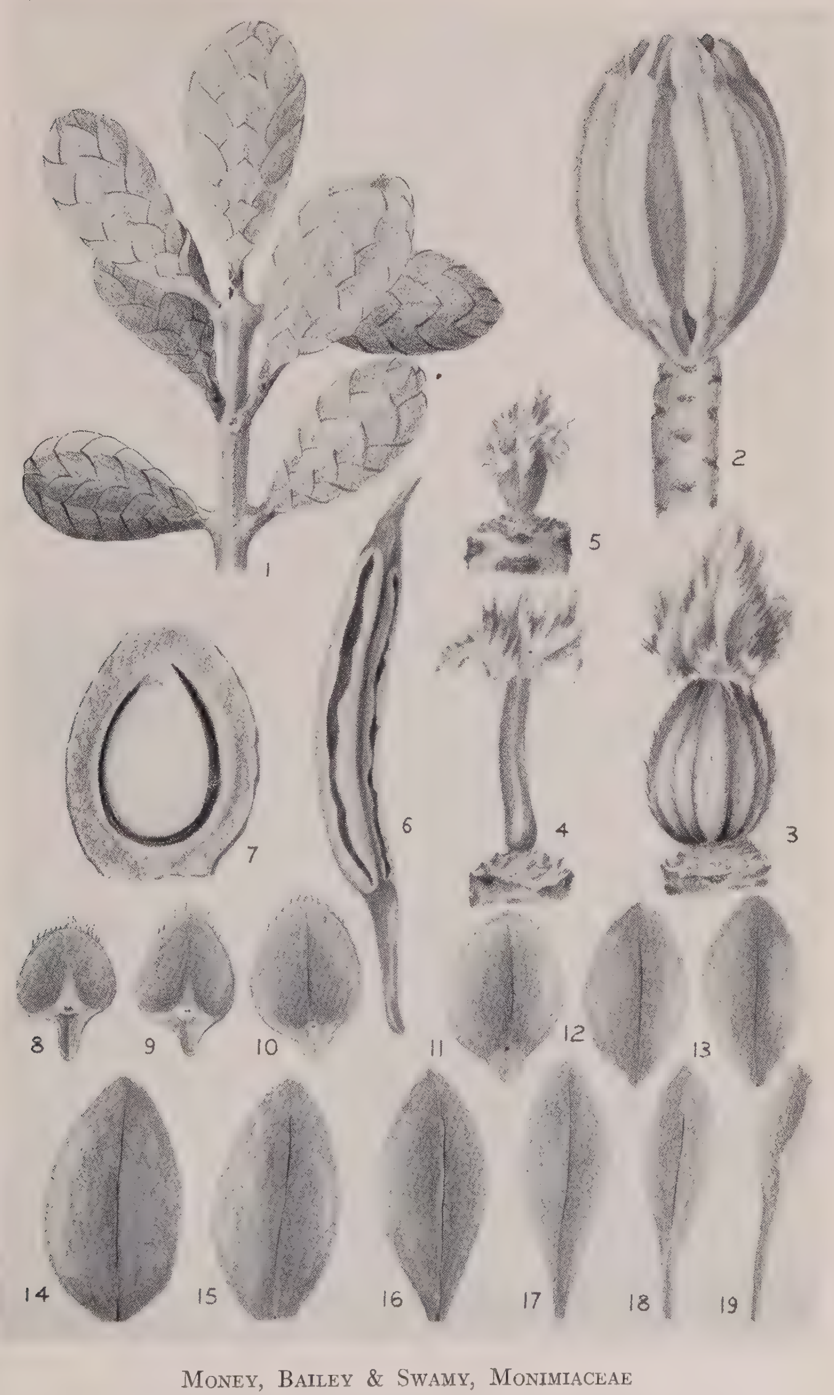
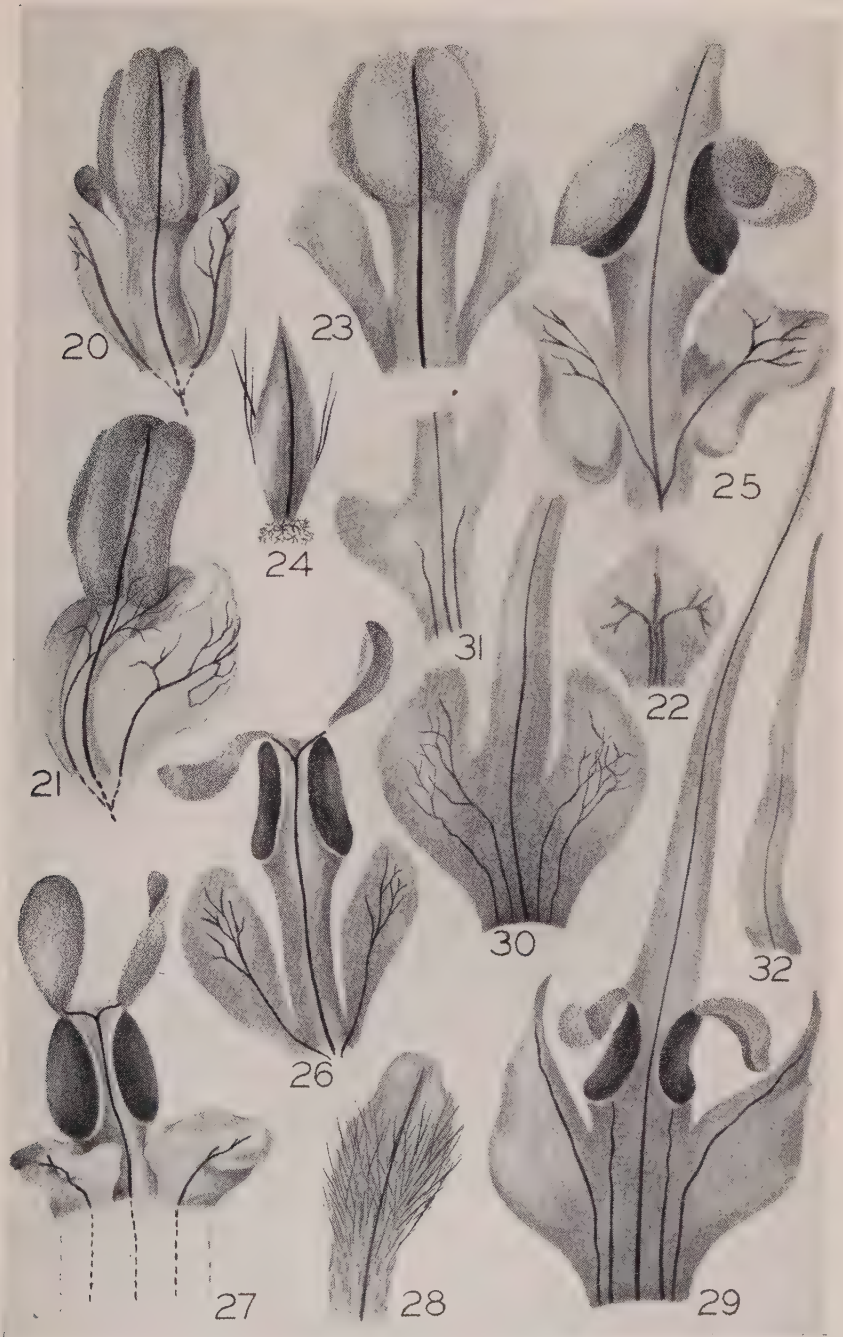
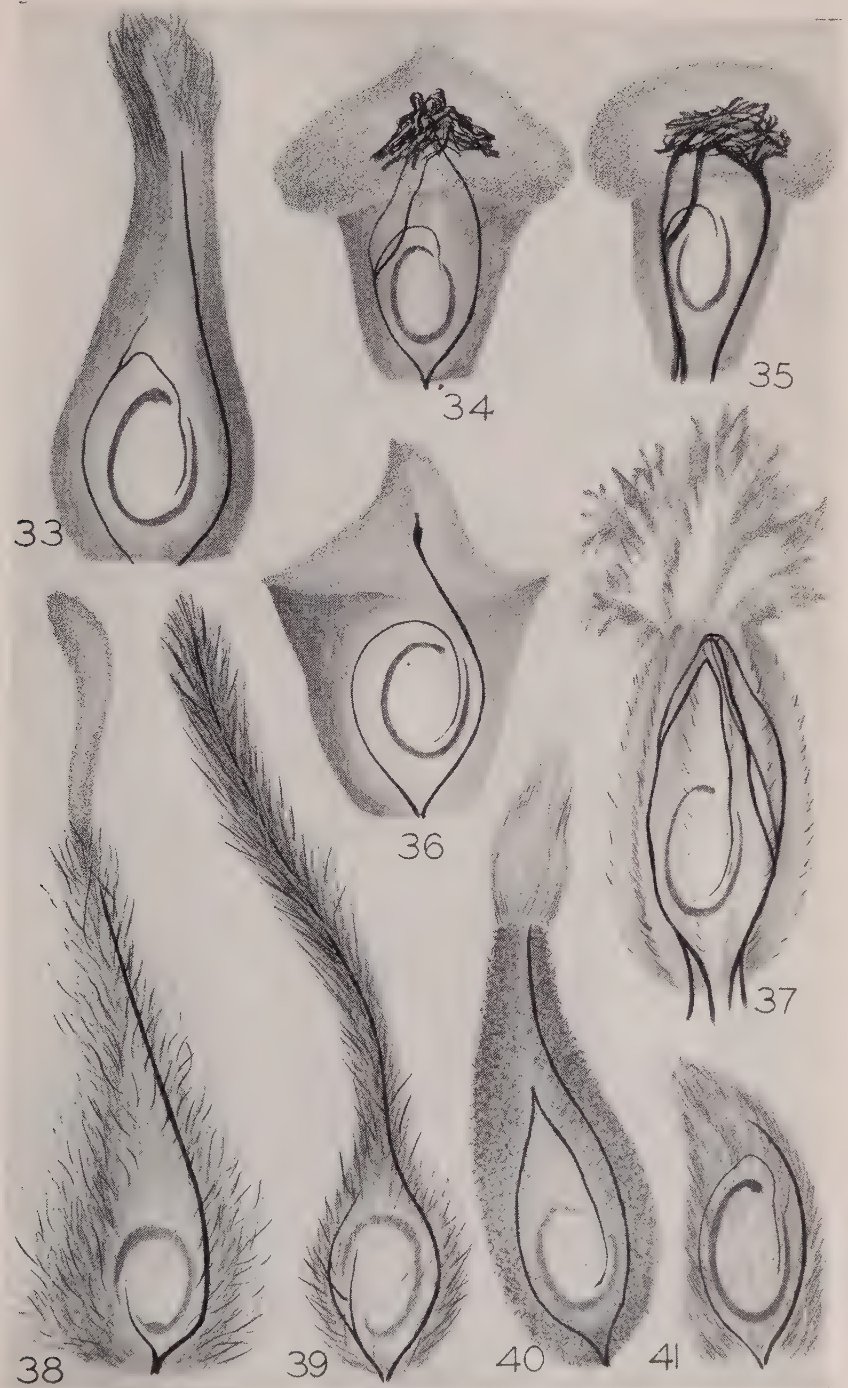


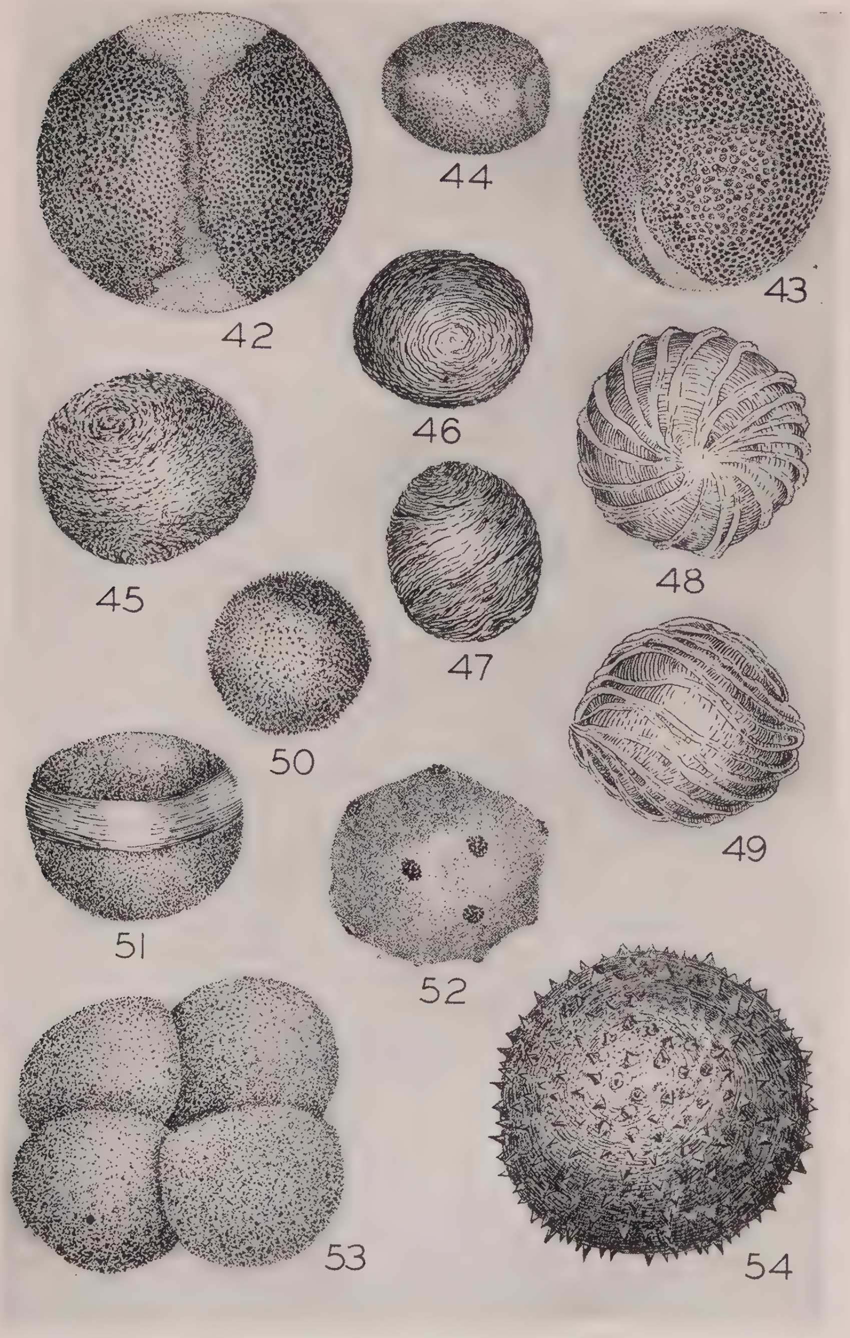
Money, Bailey & Swamy, Monimiaceae



MONEY, BAILEY & SWAMY, MONIMIACEAE



Money, Bailey & Swamy, Monimiaceae



MONEY, BAILEY & SWAMY, MONIMIACEAE

STUDIES IN THE THEACEAE, XX
NOTES ON THE SOUTH AND CENTRAL AMERICAN SPECIES OF LAPLACEA

Clarence E. Kobuski

This paper concludes the study of the American species of the genus *Laplacea.* A former effort (see Jour. Arnold Arb. 30: 166. 1949) which resulted in the publication of the West Indian species of the genus, now appears antiquated in the light of the more recent work on the South American material. The Asiatic members of the genus, of which there are approximately ten species from Malaya and Indonesia, will be treated at a later date as one of my contributions to the *Flora Malesiana,* a gigantic undertaking, parts of which are already being published under the editorship of C. G. G. J. van Steenis. Very little material of this genus from the Malayan region is to be found at present in the American herbaria. Supplementary material will be forthcoming from the herbarium of the Royal Botanic Gardens of Indonesia, Buitenzorg, Java.

Very little has been published on the genus as a whole, other than an occasional addition of new species. A few keys to the species have been offered which have proved quite unsatisfactory. The uninitiated may be annoyed to find that all keys to species throughout the literature, when given, are of an artificial nature, based almost entirely on leaf characters and pubescence. A brief study of the group, however, shows that an artificial key is probably the only type that can be presented, since the variations in flowers and fruit are so great within the single species. In fact, all the characters generally used in the delimitation of species show an equal variation — more so here than in most other genera of this very variable family.

Because of this striking variation of characters, I have found it necessary to reduce considerably the number of species. I feel now that this same practice of reduction of species should have been employed in the designation of the West Indian species, especially those of Cuba, where eight species were finally recognized, and in Haiti, where three were accepted. With more material, these eleven species will probably be reduced to two or three entities. As it was, in most of the Cuban and Haitian species, the type numbers alone were represented, and because of their variation the entities could be separated only with difficulty.

Laplacea fruticosa, a very widespread species in South America, has been collected rather abundantly. Examining only the extremes in variation within this species, one would find it difficult to place them under a single name.

In the study of the South and Central American species, types or photographs of the types of most species were available. To the far-

seeing individuals who provided the photographs and fragments (which came mostly from the Chicago Natural History Museum) I am very grateful. I am also indebted to the other institutions which made types or other authentic material available for my study.

The following abbreviations are used to designate the herbaria cited in this paper: (AA) = Arnold Arboretum; (Cal) = University of California, Berkeley; (Ch) = Chicago Natural History Museum; (G) = Gray Herbarium; (Mo) = Missouri Botanical Garden; (NY) = New York Botanical Garden; and (US) = United States National Museum.

Laplacea Humboldt, Bonpland & Kunth, Nov. Gen. Sp. **5**: 161 (207, ed. folio), *t. 461*. 1822. — DeCandolle, Prodr. **1**: 527. 1824. — Sprengel, Syst. Veg. **2**: 631. 1825. — Cambessedes in St. Hilaire, Fl. Bras. Merid. **1**: 299. 1827. — Spach, Hist. Nat. Veg. **4**: 76. 1835. — Endlicher, Gen. Pl. 1020. 1840. — G. Don, Gen. Syst. **1**: 569. 1840. — Walpers, Repert. Bot. Syst. **1**: 372. 1842; **2**: 801. 1843; **7**: 367. 1868. — Bentham & Hooker, Gen. Pl. **1**: 186. 1862. — Wawra in Martius, Fl. Bras. **12**(1): 287. 1886. — Melchior in Nat. Pflanzenfam. ed. 2, **21**: 135. 1925. — O. C. Schmidt in Fedde, Rep. Spec. Nov. Reg. Veg. **29**: 14. 1931. — Lemée, Dict. Pl. Phan. **3**: 947. 1931. — Sprague et al. in Kew Bull. **1940**: 112. 1940. — Marie-Victorin in Contrib. Inst. Bot. Univ. Montréal **49**: 69. 1944. — Kobuski in Jour. Arnold Arb. **28**: 435. 1947; **30**: 166. 1949.

Wikstroemia Schrader in Götting. Gel. Anzeig. **1821**(71): 710. May 5, 1821. — Pontin [Editor] in Vet. Akad. Handl. Stockholm **1821**: 168. 1821, obs. in footnote. — Blake in Contrib. Gray Herb. n. s. **53**: 36. 1918. — Urban, Fl. Ind. Occ. **8**: 759. 1921.

Lindleya Nees in Flora **4**: 299. May 21, 1821; op. cit. 328 (as syn. of *Wikstroemia*). June 7, 1821.

Haemocharis R. A. Salisbury, Paradisus Lond. **1**: sub. *t. 56*. 1806. — Martius & Zuccarini, Nov. Gen. Sp. **1**: 106. 1826. — Choisy in Mém. Soc. Phys. Hist. Nat. Genève **1**: 142 (Mém. Ternstr. 57). 1855. — Baillon, Hist. Pl. **4**: 253. 1873. — O. Kuntze, Rev. Gen. Pl. **1**: 62. 1891. — Szyszylowicz in Nat. Pflanzenfam. III. **6**: 185. 1893. — Urban in Bot. Jahrb. **21**: 545. 1896.

Cloaschima Korthals, Verh. Nat. Gesch. Bot. ed. Temminck 139, *t. 28*. 1842.

Trees or shrubs. Leaves coriaceous, subcoriaceous, or membranaceous, alternate, rarely asymmetrical, usually rounded or obtuse at the apex, often emarginate, tapering at the base into a short petiole or a decurrent leaf-base, the margins denticulate or crenulate, rarely entire. Flowers solitary in the axils of the upper branches, rarely in twos on a single pedicel; bracteoles 2 (or more), sepaloid, arranged along the peduncle, quickly caducous; sepals 5 (rarely more), thick-coriaceous, unequal, graduating in size and shape from bracteoles to petals, usually appressed-pubescent on the dorsal surface, deciduous, rarely persistent; petals 5, rarely more, unequal, usually membranaceous, usually emarginate at the apex and occasionally pubescent on the dorsal surface, the outer petal often resembling the inner sepal; stamens many, seriate, the filaments adnate to the base of the petals,

rarely connate their entire length forming a staminal tube and free from the petals, the anthers versatile; ovary basically 5-celled, occasionally 4-celled, rarely 6–10-celled, sericeous, the ovules 4 or more in each cell; the styles usually 5, occasionally 3 or 6, rarely 1 or absent, the stigmas usually the same in number as the styles, 5 when the style is solitary or lacking. Fruit an elongate, more or less woody loculicidal capsule with persistent columella; seeds flat or compressed, drawn out into an oblong, membranaceous wing.

TYPE SPECIES: *Laplacea speciosa* HBK.

KEY TO THE SPECIES AND VARIETIES

A. Leaves asymmetrical.
- B. Leaves serrate only along the upper portion of the margin of the extended half of the leaf.
  - C. Leaves lightly pubescent to glabrescent on the under surface, not densely sericeous. (South America to Costa Rica) ....1. *L. fruticosa.* ....1a. *L. fruticosa* var. *pulcherrima.*
  - CC. Leaves densely sericeous over the complete under surface of the leaf. (Brazil) ....1b. *L. fruticosa* var. *sericea.*
- BB. Leaves entire.
  - C. Leaves thick-coriaceous measuring up to 10 × 4 cm.; pedicels angled and robust measuring up to 5 cm. long; capsules up to 4 cm. long, 2 cm. diameter. (Colombia) ......2. *L. robusta.*
  - CC. Leaves coriaceous to subcoriaceous; pedicels terete, seldom more than 1 cm. in length; capsules 2–3 cm. long, seldom more than 1–1.5 cm. diameter...1c. *L. fruticosa* var. *symplocoides.*

AA. Leaves symmetrical.
- B. Calyx-lobes persistent, very small (ca. 3 mm. long); petals connate at the base forming a tube, with a distinctive coronate-stellate pubescence on the dorsal surface; filaments free from the petals but joined for their entire length, forming a tube. (Mexico to Panama)..3. *L. grandis.*
- BB. Calyx-lobes quickly caducous, usually 8–10 mm. long; petals joined only lightly at the extreme base, not tubular, the pubescence when present simple; filaments joined only lightly at the base and adnate to the base of the corolla.
  - C. Margin of the leaves entire.
    - D. Calyx-lobes pubescent.
      - E. Leaves 5–6 cm. long, 2 cm. or more wide. (Ecuador and Venezuela)....................4. *L. speciosa.*
      - EE. Leaves ca. 3 cm. long, 1 cm. wide. (Ecuador)..... ....4a. *L. speciosa* var. *intermedia.*
    - DD. Calyx-lobes glabrous. (Ecuador and Colombia)........ ....4b. *L. speciosa* var. *barbinervis.*
  - CC. Margin of the leaves serrulate.
    - D. Leaves subcaudate to caudate at the apex (not bluntly acuminate).
      - E. Leaves narrow-elliptic, 5–10 cm. long, 2 cm. or less wide. (Minas Geraes, Brazil).....5. *L. acutifolia.*

EE. Leaves elliptic, 10–15 cm. long, ca. 4 cm. wide. (Peru and Bolivia) ....8a. *L. pubescens* var. *subcaudata.*

DD. Leaves rounded or obtuse at the apex, occasionally bluntly acuminate.

E. Leaves always membranaceous elliptic-spathulate, rounded at the apex, abrupt- and long-tapering at the base. (Peru and Amazonas, Brazil) ....6. *L. spathulata.*

EE. Leaves membranaceous or coriaceous, obovate to lanceolate, tapering at the base, but not abruptly.

F. Leaves membranaceous.

G. Leaves obovate, lightly pubescent to glabrescent on the under surface. (Minas Geraes, Brazil) ....7. *L. obovata.*

GG. Leaves usually lanceolate, occasionally obovate, usually densely pubescent on the under surface, sometimes lightly so. (Colombia, Bolivia and Peru) ....8. *L. pubescens.*

FF. Leaves coriaceous to subcoriaceous.

G. Leaves thick-coriaceous, obovate, with a dense dirty tomentose pubescence on the under surface. (Brazil) ..9. *L. tomentosa.*

GG. Leaves subcoriaceous, obovate to oblanceolate, lightly pubescent on the under surface. (Colombia and Venezuela) ....8b. *L. pubescens* var. *camelliaefolia.*

1. **Laplacea fruticosa** (Schrader) Kobuski in Jour. Arnold Arb. **28**: 437. 1947. — G. J. H. Amshoff, Enum. Herb. Spec. Suriname Wood Coll. made by Prof. G. Stahel 24. 1948. [Reprint: Natuurwetenschappelijke Studiekring voor Suriname en Curaçao," Utrecht No. 2].

Wikstroemia fruticosa Schrader in Götting. Gel. Anzeig. **1821**(71): 711. May 5, 1821; "fructicosa." — Pontin [Editor] in Vet. Akad. Handl. Stockholm **1821**: 168. 1821, obs. in footnote. — Blake in Contrib. Gray Herb. n. s. **53**: 39. 1918.

Lindleya semiserrata Nees in Flora **4**(1): 328. June 7, 1821, nom. nud., as syn.

Laplacea parviflora [Martius in] Spix & Martius, Reise Bras. **1**: 207. 1823, nomen.

Haemocharis semiserrata (Nees) Martius & Zuccarini, Nov. Gen. Sp. **1**: 107, *t. 66*. 1826. — Choisy in Mém. Soc. Phys. Hist. Nat. Genève **1**: 144 (Mém. Ternstr. 56). 1855. — Szyszylowicz in Nat. Pflanzenfam. III. **6**: 185, 189. 1893.

Gordonia semiserrata (Nees) Sprengel, Syst. Veg. Cur. Post. **4**(2): 260, 408. 1827.

Laplacea semiserrata (Nees) Cambessedes in St. Hilaire, Fl. Bras. Merid. **1**: 300. 1827; in Mém. Mus. Genève **16**: 407, *t. 1, fig. A*. 1828. — Spach, Hist. Nat. Veg. **4**: 76. 1835. — Hooker in Curtis's Bot. Mag. **70**: *t. 4129*. 1844. — Wawra in Martius, Fl. Bras. **12**(1): 289. 1886. — Melchior in Nat. Pflanzenfam. ed. 2, **21**: 136. 1925. — Standley in Field Mus. Nat. Hist., Bot. ser. **18**: 702 (Fl. Costa Rica 702). 1937.

Laplacea semiserrata (Nees) Cambessedes β *acuminata* St. Hilaire, Fl. Bras. Merid. **1**: 300. 1827. — G. Don, Gen. Syst. **1**: 569. 1840.
Laplacea inaequilatera Schott in Sprengel, Syst. Veg. Cur. Post. **4**(2): App. 408. 1827.
Laplacea praemorsa Splitgerber in Hoeven & De Vries, Tijdschr. **9**: 100. 1842; iter. ex Mohl. Bot. Zeit. **1**: 95. 1843.
Laplacea camellioides Sonder in Linnaea **22**: 549. 1849.
Haemocharis parviflora Choisy in Mém. Soc. Phys. Hist. Nat. Genève **1**: 144 (Mém. Ternstr. 56). 1855.
Haemocharis caracasana Linden & Planchon, Trois. Voy. Linden [Bot., Pl. Columb.] **1**: 59. 1863. — Sprague in Kew Bull. **1926**: 43. 1926.
Laplacea semiserrata (Nees) Cambessedes var. *communis* Wawra in Martius, Fl. Bras. **12**(1): 289. 1886.
Laplacea caracasana Kl. & Karsten ex Wawra in Martius, Fl. Bras. **12**(1): 289. 1886, in syn.
Haemocharis camellioides (Sonder) Kuntze, Rev. Gen. Pl. **1**: 62. 1891.
Haemocharis praemorsa (Splitgerber) Kuntze, Rev. Gen. Pl. **1**: 62. 1891.
Laplacea inaequalilatera Hooker & Jackson, Index Kew. **2**: 30. 1894, sphalm.
Lindleya fruticosa Hooker & Jackson, Index Kew. **2**: 89. 1894, lapsu.
Haemocharis semiserrata Martius & Zuccarini var. α *communis* Pulle, Enum. Pl. Surinam 304. 1906.
Wikstroemia fruticosa Schrader var. *communis* (Wawra) Blake in Contrib. Gray Herb. **53**: 39. 1918.

Large trees up to 30 m. high with terete branchlets, brown or reddish brown, glabrous, sometimes appressed pubescent at the apex. Leaves usually disposed at the ends of the branchlets, occasionally along the stem, submembranaceous, subcoriaceous to coriaceous, up to 10 cm. long, asymmetrical, one side appearing constantly as half an ellipse with the widest point 0.7 cm. or less at the middle, the other side wider with the widest portion (ca. 1.5 cm.) usually above the middle, sometimes very close to the apex, rarely at the middle or below, thus effecting either an obtuse or acute apex according to the place or the extent of the extended portion, glabrous or glabrescent, occasionally pubescent along the midrib on the lower surface, usually obtuse sometimes acute at the apex, tapering to a sessile or subsessile base, the margin entire on the smaller side of the leaf, serrulate on the upper half of the larger or extended side, the veins usually obscure on both surfaces. Flowers solitary, axillary; pedicel erect or recurved, terete, usually appressed pubescent, glabrescent, ca. 1 cm. or less long; sepals 5, imbricate, concave, rounded, thick, appressed pubescent on the dorsal surface except for the membranaceous margin which is wider on the inner sepals, usually 1 cm. or less long, occasionally larger; corolla as much as 6 cm. across, usually less, ca. 3 cm. across, the petals 5 or more, obovate, white, malodorous, deeply cleft at the apex, usually ca. 1.5 cm. long and 1 cm. wide, occasionally as much as 3 cm. long and 2 cm. wide, pubescent on the median portion of the external surface; stamens very numerous, seriate, usually about one-quarter the length of the petals; ovary globose, densely sericeous when young, glabrescent,

ridged, usually 5-loculate, each locule with few ovules, the styles 5, short, glabrous, topped by 5 bifid spreading stigmas. Capsule subligneous, obovate, ridged, ca. 2 cm. long, glabrescent, usually 5-celled (occasionally more) with few seeds in each locule typical of the genus.

BRAZIL: Bahia: Igreja Velha, *J. S. Blanchet 3342* (Ch, G, US), in 1841. — Between Vittoria and Bahia, *A. Humboldt 514* (G), Feb. 1836. Paraná: Iacarehý, in silvula, *P. Dusen 15451* (G, NY, Mo, US), *15451a* (Ch, G, Mo, NY, US), Aug. 28, 1914. Rio de Janeiro: near Rio de Janeiro, *L. Riedel 7* (G), *243* (US), *1593a* (NY, US); *M. A. Glaziou 11799* (Ch, NY, US), Aug. 6, 1880; *A. Gomez 3* (Ch) in 1830. — Rio de Janeiro, Recreio dos Bandeirantes near edge of woodland and heath, *B. Lutz 708* (AA, US), Nov. 1931, *s. n.* (US), Sept. 10, 1933. — "Serra do Itatiaia, retiro in campo lapidosa," *P. Dusen s. n.* (US), June 15, 1902. Sao Paulo: Alto de Serra, *F. C. Hoehne 2373* (AA, NY, US), Aug. 20, 1918 (large tree; flowers white with a "loathsome" odor). — Jardin Botanique, *F. C. Hoehne 23832* (G), Dec. 10, 1932. Precise locality lacking: *W. J. Burchell 3123* (G) and *J. E. Pohl s. n.* (Ch).

BOLIVIA: Dept. La Paz: Prov. S. Yungas, basin of Rio Bopi, Asunta (near Evenay), *B. A. Krukoff 10622* (AA, Ch, Mo, NY), July 27–31, 1939. — Near Yungas, alt. 1300 m., *H. H. Rusby 485* (Ch, G, Mo, NY, US) in 1885.

PERU: Huanuco, Central Andean Cordillera, Mirador, along road from Acomayo to Chincas, in rain-forest, alt. 2400 m., *Y. Mexia 4137* (G), *7759* (Mo, US), Nov. 5, 1935 (tree 22 m. high with brown-gray bark and white corolla).

VENEZUELA: Terr. Fed. Amazonas: Mt. Duida, Savanna Hills, dry laterite soil at summit, alt. 1460 m., *G. H. H. Tate 787* (NY, US), Aug. 1928-April 1929. — Mt. Duida, Aguita, alt. 1000 m., *G. H. H. Tate 934* (NY, US), Aug. 1928-April 1929. Bolivar: "Cerro Sarisarinama, en les caberceras de los ríos Canaracuní y Merevari," alt. 600–800 m., *F. Cardona 380* (US), Jan. 6, 1942. Anzoategui: along Río Zumbador and tributary, near base of Piedra Blanca, northeast of Bergantin, on ridge top, alt. 1100–1450 m., *J. A. Steyermark 61344* (AA, Ch), March 1, 1945 (tree 40–60 ft.). Sucre: forest along northeast-facing quebrada tributary to Rio Manzanares, between La Trinidad and ridge connecting Cerro de Diablo (western extension of southern peak of Cerro Turumuquire), alt. 1300–1900 m., *J. A. Steyermark 62756* (AA, Ch), May 12, 1945 (tree 25–30 ft.; leaves erect, subcoriaceous, deep green above, yellow or pale green flushed with rose-lavender beneath). Merida: rich steep northwest- and northeast-facing forested slopes above "La Isla," above Tabay, alt. 2285–2745 m., *J. A. Steyermark 56641* (AA, Ch), May 18, 1944 (tree 25–85 ft.; leaves subcoriaceous, deep green above, dull paler green below). — Tovar, *A. Fendler 131, in part* (US), *132* (G). Dist. Federal: Lauteurs de Carocas, alt. 5000 ft., *J. Linden 1464* (Ch, isotype of *L. caracasana* Tr. & Pl.), Sept. 1843 (fls. blanches odorantes). Trujillo: *N. Funck & L.-J. Schlim 744* (isotype of *H. parviflora*, Ch; photo, AA, Ch).

DUTCH GUIANA: Sandrij I, in jungle, *W. A. Archer 2764* (AA, US), *2809* (Ch, US), Nov. 14–25, 1934 (tree 30–50 ft.; petals white, pink-tinged with age; scraped bark used as fish poison for small fish). — "In sylvis reg. inter. ad fl. Surinam," *Hostmann & Kappler 1287* (G, Mo, NY).

FRENCH GUIANA: along the Maroni River, *M. Melinon s. n.* (AA, US), in 1862. Precise locality lacking: *G. Wachenheim 47* (Ch), Dec. 1919.
PANAMA: Prov. Panama: Rio Indio drainage, about nine miles east of the trans-isthmian highway, rain-forest, alt. 800 ft., *W. R. Barbour 1055* (Ch), Mar. 23, 1946 (tree 100 ft.). — Cerro Campana, *P. H. Allen 2085* (Mo, US), Dec. 31, 1939 (tree 12 m. high with white fls.).
COSTA RICA: San Isidro del General Chirripó Grande Mt. in the Talamanca Range, high forest, *R. E. Danforth 48* (Ch), Aug. 20, 1936 (tall tree with small light crown; fls. malodorous, creamy white, below the leaves and facing earthward). — San Pedro de la Calabaza, alt. 1100 m., *A. Tonduz 10331* (US), Oct. 1896.

Geographically, this species is distributed from the southern states of Brazil across to Peru and Bolivia and north through Panama into Costa Rica. This distribution is by far the most extensive of any species in the genus.

Very great variation is found here in the characters most commonly employed in the delimitation of species within the family, thus making it quite difficult to present a clear-cut picture of the species. It belongs to the group having asymmetrical leaves — and in this character is quite consistent. Also the serration, varied in itself, is found only along the upper portion of the distended half of the leaf. However, in *Steyermark 56641,* two sheets carefully collected and labeled by the collector with the same number and deposited in the Chicago Museum of Natural History, both asymmetrical and symmetrical leaves are shown. One might suspect an error in numbering except that on the sheet with mostly symmetrical leaves a few leaves are found that are asymmetrical. The leaves on the Arnold Arboretum specimen of the same number are all symmetrical. I am of the opinion that dimorphism in the leaves is more prevalent in this species than is realized. Several specimens have been designated as belonging here which show clearly symmetrical herbaceous leaves serrulate along the margin on both sides. These leaves are generally on sterile specimens and may belong to young shoots. If it were not for the startling example shown by Standley and Hess in *L. grandis* (*L. Brenesii*), one would hesitate to place the specimens here — or even in the genus. Because of the element of doubt in the mind of the present author, these specimens have not been cited above. They are *Steyermark 56409* and *Pittier 14386* from Venezuela, *Archer 2708* from Dutch Guiana, *Espina & Giacometta A37* and *A160* from Colombia, and *Barbour 1001* and *1009* from Panama.

The shape of the leaf often varies to such an extent that it makes difficult a decision as to the lines of specific demarkation. The apex of the leaf is generally quite obtuse, and the widest portion of the leaf is near the apex. However, this is not always the case. It appears that on this asymmetrical (the larger) half of the leaf, the widest portion may be found at the middle or rarely even below the middle. In such cases the apex is quite acute — even acuminate in some instances. Two specimens, *Tate 787* and *934,* from the same general locality, Mt. Duida, illustrate this variation. In *Tate 787* the widest portion of the leaf is near the apex and

measures as much as 2.5 cm. across. Here the apex is quite obtuse. In *Tate 934* the widest portion is at or below the middle of the leaf and measures ca. 1 cm. The apex in the latter specimen is definitely long-acuminate. In all instances in the material studied the variation appears to be caused by the position and width of the wider half of the leaf. On the other half of the leaf hardly any variation is found.

The size of the flower also has presented difficulty in delimitation, and both species and varieties have been described which in truth belong to this variable species. I feel that the flowers generally most characteristic of the species are those that measure ca. 3.5 cm. across, in which the petals measure 1.5 × 1.2 cm. However, one frequently finds flowers measuring as much as 6 cm. across, with the individual petals measuring 3 × 2 cm. — as large as the whole flower mentioned above. Two specimens collected by P. Dusén at the same locality (Iacarehý, Bahia) in Brazil illustrate this variation. Dusén numbered his specimens *15451* and *15451a*. In all respects other than flower size these two numbers are identical. In *Lutz s.n.* in the U. S. National Museum both large and small flowers are found on a single branch.

This species has been known for many years as *Laplacea semiserrata*, based on *Lindleya semiserrata* Nees. For clarification concerning the name I quote from a previous publication (Kobuski in Jour. Arnold Arb. 28: 436. 1947).

"Because of the obscurity of the publications, I relate below in detail the circumstances concerning the early publications of the names *Wikstroemia fruticosa* Schrader and *Lindleya semiserrata* Nees.

"In the short span of 33 days in the year 1821 the real story of the genus was unfolded. On May the fifth, 1821, Schrader, in Göttingische gelehrten Anzeigen (No. 72, p. 710), a publication which evidently appeared three times weekly, published the new genus *Wikstroemia,* and on the following page listed a single species *W. fruticosa,* spelled "fructicosa." This new binomial was based on a specimen (no. 15), collected by Prinz Maximilian von Neuwied in Brazil. The generic description was in Latin and as complete as any of the descriptions for members of the Theaceae at that time. There could be no questioning of the date since a date appeared on every leaf of the publication, varying, of course, with the time of publication.

"In the same month, at Regensburg, on May the twenty-first, Nees, in volume 4 of Flora, known also as Botanische Zeitung Regensburg (no. 19, p. 299), published a new genus *Lindleya,* giving no specific name, however. Nees had received a duplicate set of the Brazilian plants collected by Prinz Maximilian von Neuwied. By an odd coincidence Nees based his new genus *Lindleya* on the same Neuwied number which Schrader had cited in his publication of approximately two weeks earlier.

"It may be assumed that Nees saw Schrader's publication of May 5, 1821, very shortly after it appeared, for on June 7 Nees (Flora vol. 4, p. 328) listed the combination *Lindleya semiserrata,* but merely as a syno-

nym of *Wikstroemia fruticosa.* He mentioned that his own work on the collection was in manuscript form and in the hands of the collector (Neuwied) at the time. He further stated that he would rescind his earlier abstract (presumably that of May 21, 1821), since its publication was antedated by that of Schrader. He wrote also that, since it would be very instructive to see just how he agreed or disagreed with Schrader's treatment, he would offer a bit of amusement for the readers of 'Flora' by listing his synonyms along with the original names of Schrader.

"There seem to have been approximately fifty numbers in the set of specimens worked over by Schrader. Nees' set was less complete, since he listed twelve numbers as missing from his set. Of the approximate thirty-five numbers which the two workers had in common, Nees offered synonyms for fifteen of Schrader's new species. Of course these synonyms of Nees were all actually new combinations. His manner of listing is as follows: '15. Wickstroemia fruticosa Schr. ist Lindleya semiserrata m.'

"Just what feeling existed between the botanists of that time is difficult to ascertain; also the circumstances regarding the publication of the identifications on the Prinz Maximilian von Neuwied collection. At any rate, in the same year, Sprengel, in Vet. Akad. Handl. Stockholm 1821: 167. 1821, published a second genus, *Wikstroemia* (Compositae), named after the same Dr. J. E. Wikström. He ignored Schrader's genus of the same name, failing to mention its existence. A footnote by the editor drew attention to Schrader's earlier *Wikstroemia* but stated that it was understood to be merely a synonym of Nees' *Lindleya*. The exact month of the last-mentioned publication is not certain. However, the complete action involving this confusion in synonymy took place in less than eight months!

"In the following year (1822) Humboldt, Bonpland & Kunth (Nov. Gen. Sp. Pl. 5: 207) introduced the genus *Laplacea,* the name now conserved by the 'International Rules.' The date printed in the front of the volume was 1821, which might have confused the issue even further. However, according to Barnhart in Bull. Torrey Bot. Club 29: 595. 1902, the date of publication has been ascertained as 1822, rather than 1821. The type-species was in no way involved by the creation of the genus *Laplacea,* since H. B. & K. described *L. speciosa* from Peru in their work, not the species under discussion. *Laplacea speciosa* was designated as the type of the genus when the generic name *Laplacea* was conserved.

"Four years later (1826), Martius and Zuccarini in Nov. Gen. Sp. 1: 107, *t. 66,* entered still another name, *Haemocharis,* and used the binomial *H. semiserrata. Lindleya* Nees was reported in the synonymy of *Haemocharis,* but not the binomial *L. semiserrata.*

"The next year (1827), Cambessedes, in St. Hilaire, Fl. Bras. Mer. 1: 300, accepted *Laplacea* and transferred thereto *Haemocharis semiserrata,* attributing the parenthetical authorship to Martius & Zuccarini. Since that time the species has been recorded under either *Laplacea* or *Haemocharis* with the specific name 'semiserrata.' "

1a. **Laplacea fruticosa var. pulcherrima** (Melchior), comb. nov.

Laplacea pulcherrima Melchior in Nat. Pflanzenfam. ed. 2, **21**: 136. 1925.

PERU: exact locality not given, *A. Weberbauer 9749* (TYPE, Berlin [not seen]; photo Ch, G).

BRAZIL: Amazonas: Municipality Humayta, on plateau between Rio Livramento and Rio Ipixuna, on campinarana, *B. A. Krukoff 7005* (AA, Ch, NY, US), Nov. 1934 (tree 70 ft. high). Para: Belem, Utinga, forest, sandy banks of river, *A. Ducke 832* (Mo, US), Nov. 7, 1941 (moderate-sized tree with white flowers). — Belem, *J. Huber 1675* (US), Nov. 1899. — Obidos, *A. Ducke 15121* (US), Dec. 10, 1913.

This variety is not extremely distinctive from the species, being characterized by larger leaves (12 × 3 cm.) and flowers, and strong silky sepals. The petals in the type measure ca. 2 cm. long, which is not unusually large when compared with some of the Brazilian representatives of the genus. In the specimens cited above the serration is less pronounced than in most representatives of the species. Like several other theaceous species offered by Melchior, the description is quite incomplete, consisting only of the characters as used in the key.

In distribution this variety appears to be confined to the Amazon valley, extending from Peru across Brazil through Amazonas to Para.

1b. **Laplacea fruticosa var. sericea** (Wawra), comb. nov.

Laplacea semiserrata (Nees) Cambessedes var. *sericea* Wawra in Martius, Fl. Bras. **12**(1): 290. 1886.

BRAZIL: Rio de Janeiro: Nova Friburgo, *M. A. Glaziou 11798* (photos of TYPE of *L. semiserrata* var. *sericea,* Ch, G; fragment, Ch), in 1881.

Only a single leaf and a photograph of the type have been available for this study. The outstanding character which separates the variety from the species is a dense silvery sericeous pubescence on the under surface of the leaf, the younger branchlets, and the calyx and pedicel. The leaf is generally smaller, measuring 4–6.5 cm. long and 1–1.5 cm. wide, asymmetrical, and lightly dentate near the apex on one side.

Wawra described the leaves of this variety as ". . . integris, aequilateris . . ." This is very misleading, since close observation shows the margin to be dentate and the outline clearly asymmetrical.

The variety appears to be very rare, having been collected only once. Material typical of the species was collected by Glaziou in the same locality and probably at the same time, since the two numbers are consecutive.

1c. **Laplacea fruticosa var. symplocoides** (Triana & Planchon), comb. nov.

Laplacea symplocoides Triana & Planchon in Ann. Sci. Nat., sér. 4, **18**: 269. 1862. — Walpers, Ann. Bot. **7**: 367. 1868. — Wawra in Martius, Fl. Bras. **12**(1): 291. 1886. — Melchior in Nat. Pflanzenfam. ed. 2, **21**: 136. 1925.

Haemocharis symplocoides (Triana & Planchon) O. Kuntze, Rev. Gen. **1**: 62. 1891, as *"H. symplocodes."* — Szyszylowicz in Nat. Pflanzenfam. III. **6**: 185. 1893.

Wikstroemia symplocoides (Triana & Planchon) Blake in Contrib. Gray Herb. n. s. **53**: 41. 1918.

COLOMBIA: "Alto Batatas, andes de Bogata," alt. 2500 m., *J. Triana 1866* (TYPE of *L. symplocoides;* photo, AA, Ch). — Caldas, *M. T. Dawe 790* (NY, US), in 1918 (handsome flowering tree). — Dept. de Huila, Cordillera Oriental, "vertiente occidental, bosques más arriba de Guadalupe en Resina," alt. 1850–1900 m., *E. P. Arbelaez & J. Cuatrecasas 8344* (US), March 20, 1940 (tree 30 m. with the trunk 60 cm. diam.; fls. white or greenish white). VENEZUELA: Merida: Párama del Molino, alt. 2600 m., *A. Jahn 941* (US), Jan. 19, 1922. — Dwarf cool forest between El Molino and ridge above San Isidro Alto, alt. 2430–2895 m., *J. A. Steyermark 56520* (AA, Ch), May 14, 1944 (shrub 5–10 ft. tall; flowers showy, malodorous, the perianth white, the sepals pale greenish white tinged with lavender, the anthers golden with whitish filaments; leaves coriaceous, dark green above, paler green below).

ECUADOR: Prov. Carchi, Canton Tulcan, Los Olivos, on slopes of virgin forest, alt. 3200 m., *Y. Mexia 7460* (Cal, G, US), July 11, 1935 (tree 23 m. tall, the circumference 1 m. at 2 ft.).

It appears that the only character in which this variety consistently differs from the species is in the entire margin of the leaf. In fact, most of the specimens cited above have been identified with the species at one time or another. Of the specimens examined, *Jahn 941* from Venezuela and *Mexia 7460* from Ecuador match the type (photograph) most closely.

The apex of the leaf is usually quite obtuse, often rounded, with the largest portion of the extended half nearest the apex. The tapering of the leaf toward the apex is less abrupt in the variety.

It is difficult to associate Steyermark's *56520,* a shrub 5–10 ft., with Mexia's *7460,* which is a tree with a circumference of one meter at 2 ft. from the ground. Mexia adds that her specimen was taken from one of the smaller trees of the group. However, this variation, though seldom as extreme as this, is often found in other species of the family.

Cited here, perhaps, may be *Steinbeck 8937* from Bolivia. This is a sterile specimen but seems most closely related to this variety.

2. **Laplacea robusta,** spec. nov.

Arbor parva (ca. 8 m.) vel grandis (fide coll.), ramulis teretibus glabris, crasso-robustis, rubris vel brunneo-rubris, cortice mox exfoliata. Folia in ramuli apice conferta, erecta, crasso-coriacea, sessilia, inaequilatera, ad 10 cm. longa et 4 cm. lata, apice obtusa vel rotundata, basi late attenuata, utrubique glabra, costa supra canaliculata (raro juventute pubescentia), subtus elevata, margine recurvata, integerrima, nervis obscuris. Flores non visi. Fructus axillares, solitarii, pedicello robusto 3–5 cm. longo, ca. 5 mm. diametro, angulato, glabro; capsula glabrescente ad 4 cm. longa, obovata, apice ca. 2 cm. diametro, 5-angulata, 5-loculata, seminibus paucis, typicis.

COLOMBIA: "Departamento del Huila-Conmisaria del Caquetá: Cordillera Oriental sobre el filo divisoria, en Gabinete," alt. 2300–2450 m., *J. Cuatrecasas 8476* (US, TYPE; fragment and photo, AA), March 22, 1940 (small tree 8 m. high or large tree; flowers white, odorous).

This new species belongs to the group of species known to possess asymmetrical leaves and appears to be most closely allied to *L. fruticosa* var. *symplocoides*. In both entities the leaves are entire along the margin. However, in *L. robusta* the leaves are larger and more thickly coriaceous. The pedicels are angled and much larger, measuring up to 5 cm. long and 5 mm. in diameter, erect and glabrous. The fruit on the long, robust pedicel is corresponding in size, measuring up to 4 cm. long, easily the largest seen in any American species. Although flowers are not available for this study, I am sure that when collected they will be easily recognized as belonging to this species, since in size they will probably correspond to the known parts of *L. robusta*. Although only mature fruits are found on the type, the collector mentions that the flowers are white and odorous.

The plant is for the most part glabrous. The ovary, like that of all species of the genus, was obviously quite pubescent. In the development of the fruit this pubescence is lost. The leaves are glabrous except for a fine growth of pubescence found in the canaliculate midrib on the dorsal surface of the younger leaves. This pubescence vanishes with age.

Although no mention is made by the collector of the red coloration on the branchlets and leaves, it is obvious that along the midrib and the base of the leaves the red color characteristic of many species of this family is present. This deep red color appears to be present on the fruit also.

The bark on the young branchlets is definitely exfoliate. This character is not new to the group but is quite uncommon.

3. **Laplacea grandis** T. S. Brandegee in Univ. Calif. Publ. Bot. 6: 186. 1915. — Melchior in Nat. Pflanzenfam. ed. 2, 21: 136. 1925.

Wikstroemia grandis (Brandegee) Blake in Contrib. Gray Herb. n. s. 53: 40. 1918.

Laplacea Brenesii Standley in Field Mus. Publ. Bot. (Fl. Costa Rica) 18: 701. 1937. — Record in Trop. Woods 70: 30. 1942; 80: 2. 1944.

Laplacea Williamsii Standley ex Ll. Williams in Lilloa 4: 145, 165. 1939, *nomen*.

Large trees up to 30 m. high; the top rounded, the bark gray; branchlets numerous, subterete, glabrous except for pubescent new growth. Leaves congested at the apex, stiff-coriaceous [membranaceous],* quite symmetrical, pubescent when young, quickly glabrescent, ovate, elliptic or obovate, 9–15 cm. long, 3–5 cm. wide [20–30 cm. long, 9–11 cm. wide], acuminate at the apex, tapering at the base into a short petiole [base subauriculate], the margin crenate-serrate, the midrib plane or somewhat canaliculate above, elevated beneath, the veins 8–12 pairs [10–17 pairs, very prominent], conspicuous on both surfaces. Flowers axillary, solitary or in pairs on a single peduncle; peduncle terete, ca. 3 cm long, finely tomentose with mixed pubescence, the pedicels of similar length and characteristics; sepals 5, persistent, imbricate, very small, ca. 3 mm. long, rounded, densely covered with a minute matted mixed pubescence, con-

* The bracketed portions of the above description refer only to a second form, discussed below.

spicuously ciliate; petals white, obovate, 1.5–2 cm. long, 0.8–1–2 cm. wide, rounded at the apex, conspicuously connate for ca. 5 mm. at the base, forming a tube, the outermost petal thicker and wider (2 cm.), finely stellate-pubescent on the dorsal surface, densely so on the whole dorsal surface of the outer petal, lightly so on the basal or median portion of the inner petals; stamens very numerous, 6–7 mm. long, the filaments joined for the entire length or nearly so, forming a staminal tube, the anthers oblong, 1.5 mm. long and 0.5 mm. wide; ovary oblong-elliptic, densely sericeous, especially near the base, 5-celled, the style lacking, the stigma 5-lobed, stellate, fitting together at the apex and extending down the side of the ovary. Capsule ovoid or globose, 2–3 cm. long, 1–2 cm. wide, pubescent, 5-loculate, the seeds winged, ca. 15 mm. long, 5 mm. wide.

Typical material with flowers or fruit:

MEXICO: Chiapas: Finca Mexiquito, *C. A. Purpus 7092* (type, Cal), July 1913 (very large tree). — Finca Irlanda, *C. A. Purpus 7120* (Cal), Sept. 1913. Oaxaca: midway between Monte Negro and San Juan Lalano, lat. 17°26′, long. 95°45′, alt. 450 m., *R. E. Schultes & B. P. Reko 798* (AA), May 6, 1939 (very large tree). — Ubero, *Ll. Williams 9170* (Ch, Mo, US), April 1937.

COSTA RICA: Prov. Alajuela: Los Angeles de San Ramón, in forest, alt. 1050 m., *A. M. Brenes 4379* (type of *L. Brenesii*, Ch), Aug. 21, 1925 (tree 8–10 m.; fls. white, very fragrant). — Between La Balsa and Cataratas de San Ramón, in woods and fields, alt. 850 m., *A. M. Brenes 4506* (Ch), Oct. 12, 1925 (tree 15–20 m. with white flowers). — La Palma de San Ramón, in forest, alt. 1050 m., *A. M. Brenes 5357* (Ch), *5791* (Ch), Jan. 16 & Nov. 10, 1927 (tree 30–40 m.). — La Palma y El Socorro de San Ramón, *A. M. Brenes 6201* (AA, Ch, US), *6201a* (AA), *6215* (Ch), July 1928. Prov. Guanacaste: Canas Goedas, alt. 1100 m., *H. Pittier 11176* (US), Feb. 28, 1897.

GUATEMALA: Dept. Zacapa: Sierra de la Minas, between Cerro de Monos and upper slopes of Monte Vergen, alt. 2000–2600 m., *J. A. Steyermark 42880* (AA, Ch), Jan. 17, 1942 (leaves stiff-coriaceous, rich shining green above, pale green beneath).

PANAMA: Prov. Panama: Rio Indio drainage about nine miles from trans-isthmian highway, rain-forest, alt. 800 ft., *W. R. Barbour 1053* (Ch), Mar. 23, 1946 (tree 80 ft.).

Atypical sterile material:

GUATEMALA: Dept. San Marcos: south-facing slopes of Volcán Tajumulco, alt. 1300–1600 m., *J. A. Steyermark 37361* (AA, Ch), *37544* (Ch), March 1940 (leaves firmly membranaceous). Dept. Zacapa: Sierra de la Minas, slopes of Monte Virgen, around summit of mountain, alt. 2200–2400 m., *J. A. Steyermark 42611a* (Ch), Jan. 1942 (tree 30 ft. tall; leaves firmly chartaceous, rugose above). Dept. Sololá: Volcán San Pedro, north-facing slopes toward Lago de Atitlan, above village of San Pedro, in damp cloud forest dripping with mosses and hepatics, alt. 8300–9400 ft., *J. A. Steyermark 47252* (Ch), June 7, 1942. Dept. Alta Verapaz: large swamp just east of Tactic, alt. 1300 m., *J. A. Steyermark 43992* (Ch), Feb. 1942 (tree 75–100 ft., leaves firmly membranaceous). — Mountain along road between Tactic and the divide on the road to Tamahú,

dense wet forest, alt. 1500–1600 m., *P. C. Standley 91355* (Ch), April 1941 (shrub). — Near Tactic, wooded swamp, alt. ca. 1500 m., *P. C. Standley 91576* (Ch), April 10, 1941 (shrub).

HONDURAS: summit above El Achote, above the plains of Siguatepec, in thickets at the edge of the forest, alt. 1800 m., *T. G. Yuncker, R. F. Dawson & H. R. Youse 6201* (Ch), July 7, 1936 (small tree 12 ft. high).

This species, which extends geographically from southern Mexico to Panama, may be distinguished from all other species of the genus by the following characters: (1) The calyx-lobes are unusually small for the genus, measuring only ca. 3 mm. in length, and are persistent, resembling more those found in the genus *Cleyera*. (2) A characteristic crown-like stellate pubescence is found on various parts of the leaves and flowers and is especially noticeable on the dorsal surface of the inner corolla-lobes. (3) Although usually solitary and axillary, frequent occurrences of at least two flowers on a single peduncle are noted. (4) The corolla is tightly compressed, appearing globose well after the small calyx-lobes have opened, due for the most part to the thicker, larger and concave outer corolla-lobe. The corolla is also connate at the base for approximately 5 mm. in the form of a tube. (5) The filaments are united in a distinct tube, with the anthers free.

This species differs from the other members of the genus in so many characters that one might be inclined to consider it generically distinct. However, research carried on by Record at Yale convinced him that anatomically it belongs to *Laplacea.*

In the citation of specimens above it will be noted that two categories are listed, namely: "Typical material with flowers or fruit" and "Atypical sterile material" — how else to cite them I do not know. It is difficult for me to accept the so-called "atypical" material as belonging to this species, not to mention the genus. However, it seems that after having been baffled for some time by this material, P. C. Standley sent wood specimens to Record at Yale for study and Record not only designated this family but also stated that "the exact species was indicated — *Laplacea Brenesii* Standley." Considering this extraordinary variation of great interest I am quoting below the short note published by Record in Tropical Woods (80: 2. 1944) concerning this variation.

"Identifying *Laplacea Brenesii.*

"Following is a striking instance of the aid a wood anatomist may be able to give a taxonomist working with sterile herbarium material. Recently I received from Paul C. Standley, of the Chicago Natural History Museum, a small piece of wood collected by Mr. Steyermark in Guatemala. He wrote that he had at least seven collections of the same tree from different parts of Guatemala and some others from Honduras and Panama, and added that the leaves looked to him more like *Meliosma* than anything else.

"Fortunately for my purpose the wood in question has solitary vessels and scalariform perforation plates so that it was a very simple matter to

find it in two of the keys of the series I have been publishing. Furthermore, the exact species was indicated -- *Laplacea Brenesii* Standley.

"I reported my findings to Mr. Standley and by return mail received his confirmation of my diagnosis. 'There is no question as to the correctness of the name, but the variations in foliage are extraordinary. The leaves of sterile young branches are *very* unlike those of fertile branches. We have just one fertile collection (in old fruit) from Guatemala, so weatherbeaten that for some time I did not recognize the family. If it and the sterile specimens were put side by side, few botanists would recognize any connection between them, just as in my case.

" 'Incidentally, one of the sterile specimens from Honduras was written up once by [another botanist] as a new species of *Quercus,* but I realized that it was at least no *Quercus* and suppressed the description.'

"*Laplacea Brenesii* differs from the other species of the genus particularly in its coarser texture. According to C. L. Lankester (see *Tropical Woods* 70: 30), it is abundant in the Cartago region of Costa Rica and in demand for scantlings for house and mill construction, but warps too badly in seasoning to make good boards."

The material is all labeled in Standley's characteristic handwriting. So different is it from the typical material of this species, that, were I to come upon an unlabeled sheet, I am afraid that I would continue to confuse it with some family other than Theaceae.

One thing the two groups have in common is a stellate pubescence. However, listed below are some of the variations.

Typical	**Atypical**
Leaves stiff-coriaceous	Leaves membranaceous or chartaceous
Leaves 9–15 cm. long, 3–5 cm. wide	Leaves 20–30 cm. long, 9–11 cm. wide
Leaves generally ovate	Leaves obovate
Leaves tapering so finely at the base that a decision concerning a petiole is difficult	Leaves subauriculate at base
Veins 8–12 pairs, obvious to obscure	Veins 10–17 pairs, very prominent

All specimens of the "atypical" material are sterile. One might assume these to have been collected from young growing shoots, thus accounting for this great variation. However, *Steyermark 43932* is recorded as a tree 75–100 ft. high and *Steyermark 37361* as a tree 20–30 ft. high.

There is no doubt in my mind, having had an opportunity to study the types of both *L. grandis* and *L. Brenesii,* that a single species is here represented. So much more publicity has been given the species under the latter name that it is with regret that I find it necessary to reduce it to synonymy.

4. **Laplacea speciosa** HBK., Nov. Gen. & Sp. 5: 209 (162, ed. folio), *t. 461.* 1822. — J. Kerner, Gen. Pl. Ill. 6: *t. 104.* 1822. — Sprengel, Syst. Veg. 2: 631. 1825. — G. Don, Gen. Syst. 1: 569. 1840. — Melchior in Nat. Pflanzenfam. ed. 2, **21**: 136. 1925.

Haemocharis speciosa (HBK.) Choisy in Mém. Soc. Phys. Hist. Nat. Genève **1**: 144 (Mém. Ternstr. 56). 1855. — O. Kuntze in Rev. Gen. Pl. **1**: 62. 1891. — Szyszylowicz in Nat. Pflanzenfam. III. **6**: 185. 1893.

Laplacea insignis Bentham, Pl. Hartweg. 126. 1843, *lapsu.*

Wikstroemia speciosa (HBK.) Blake in Contrib. Gray Herb. n. s. **53**: 40. 1918.

Laplacea spectabilis Moricand, Plantae Amer. Rar. 3, 1830, *lapsu.*

Large tree; branches sparse, terete, gray, pilose-sericeous when very young becoming glabrous, roughened, eventually exfoliating in minute sheets. Leaves crowded at the apex of the branchlets, coriaceous, symmetrical, obovate, ca. 4.5 cm. long and 2 cm. wide, occasionally larger, sessile (appearing petiolate because of the decurrent base), obtuse to subrotund at the apex, usually slightly retuse, tapering at the base, the margin entire, somewhat revolute, especially toward the base, the veins obscure on both surfaces, occasionally very lightly tufted with pubescence at the apex of the under surface. Flowers axillary, solitary, the pedicel terete, slightly recurved, appressed-pubescent, usually less than 1 cm. long; sepals imbricate, usually 5, concave, quite rounded, ca. 7–8 mm. long, densely sericeous on the dorsal surface, thinly membranaceous along the margin; petals white, obovate, obtuse, usually deeply emarginate at the apex, ca. 3 cm. long and 1.5 cm. wide, occasionally larger, sericeous along the median portion of the external surface, the stamens numerous, ca. one-fourth the length of the petals, adnate to the base of the petals, the ovary densely sericeous, ridged, 5-celled, pauci-ovulate, the styles 5. Capsule woody, glabrescent, up to 2 cm. long, 5-angled, 5-valved, each cell with few seeds.

ECUADOR: Loja: "Crescit rarissime in sylvis inter Gonzanamam et urbem Loxae, alt. 1060 hexapod.," *A. Humboldt 3340* (photo of TYPE, Ch). — S. Loja, "Namanda," alt. 2400–2500 m., *R. Espinosa E 170* (AA, NY), April 18, 1946 (tree; leaves coriaceous, shiny; corolla white, somewhat fleshy).
VENEZUELA: Merida, Páramo del Molino, alt. 2800 m., *A. Jahn 896* (G, US), Jan. 24, 1922.

This species and the two following varieties appear to inhabit only the higher altitudes of the Andes mountain range in South America. Few specimens of this species seem to have been collected.

The outstanding characters are the glabrous symmetrical leaves, quite obtuse or rounded at the apex, with the margin entire. The calyx is appressed-pubescent on the external surface.

Only a photograph of the type was available for this study. However, laid out on the sheet were most of the floral parts as well as a rule, thus making it possible to obtain quite accurate measurements.

Also, a great help was the authentic specimen collected by *R. Espinosa* (*E 170*) from the type locality.

4a. **Laplacea speciosa** var. **intermedia** (Bentham), comb. nov.

Laplacea intermedia Bentham, Pl. Hartweg. 126. 1843. — Wawra in Martius, Fl. Bras. **12**(1): 290. 1886. — Melchior in Nat. Pflanzenfam. ed. 2, **21**: 136. 1925.

Haemocharis intermedia (Bentham) Choisy in Mém. Soc. Phys. Hist. Nat. Genève **1**: 144 (Mém. Ternstr. 56). 1855. — O. Kuntze, Rev. Gen. Pl. **1**: 62. 1891. — Szyszylowicz in Nat. Pflanzenfam. III. **6**: 185. 1893.

Wikstroemia intermedia (Bentham) Blake in Contrib. Gray Herb. n. s. **53**: 40. 1918.

ECUADOR: Loja: in mountains near Loja, *T. Hartweg 717* (fragm. of TYPE of *L. intermedia*, AA, Ch), 1841–1843. — Horta-Naque, in the high forest, alt. 3500 [m.], *R. Espinosa E 1023* (AA, NY), Nov. 9, 1946 (tree 6–10 m. high; leaves coriaceous; flowers white with rose-tinted exterior).

This variety, originally described as *L. intermedia* by Bentham in 1843, was based on a specimen collected by Hartweg (*717*) in the mountains of Ecuador near Loja between the years 1841 and 1843. Only a single specimen of this entity, as far as I know, has been collected since — and this just recently (1946) by Dr. Reinaldo Espinosa, probably from a locality close to that of the original specimen. Although the altitude of the place where the type was collected has not been recorded, one may be quite correct in assuming from the Espinosa collection at 10,500 ft. that the plant grows only at this very high altitude, and this assumption if justified by fact may account for the absence of specimens in American herbaria.

Comparing the fragment of the type and Espinosa's specimen with material of *L. speciosa,* the only differences appear to be the lower habit (tree 6–10 m.), the crowded branchlets, and the smaller leaves.

Some of the measurements, along with descriptive characters of *Espinosa E 1023,* are recorded here. When young, the branchlets are smooth, quite terete, and dark red in color, punctuated along the length by closely arranged leaf scars. The total length of the branchlets seldom exceeds 10 cm. In age the bark becomes gray, and is broken into small sections which eventually exfoliate. The leaves are coriaceous, small (measuring 3 × 1.2 cm.), obovate, symmetrical, entire, slightly retuse at the apex with occasional small tufts of hairs at the apex on the under surface (otherwise glabrous), thus resembling the variety *barbinervis.*

The flowers are solitary and axillary with short terete pedicels (ca. 0.5 cm. long) which are close-appressed-pubescent. The calyx-lobes are rounded, concave, appressed-pubescent and ca. 8 mm. long. The petals measure about 2 cm. in length.

The fruit is correspondingly small for the genus, measuring ca. 1 cm. in length, and is typically glabrescent.

4b. **Laplacea speciosa** var. **barbinervis** (Moricand), var. nov.

Laplacea barbinervis Moricand, Plantae Americanae Rariores 3, *pl. 2.* 1830; Plantes Nouvelles d'Amérique 16, *t. 11.* 1836; in Mém. Soc. Phys. Hist. Nat. Genève **7**: 256, *t. 11.* 1836. — Guillemin in Bull. Sci. Nat. et Geol. **23**: 78. October 1830. — Walpers, Repert. Bot. Syst. **1**: 372. 1842. — Melchior in Nat. Pflanzenfam. ed. 2, **21**: 136. 1925.

Gordonia barbinervis (Moricand) Walpers, Repert. Bot. Syst. **1**: 375. 1842.

Haemocharis barbinervis (Moricand) Choisy in Mém. Soc. Phys. Hist. Nat. Genève **1**: 144 (Mém. Ternstr. 56). 1855. — Szyszylowicz in Nat. Pflanzenfam. III, **6**: 185. 1893.

Wikstroemia barbinervis (Moricand) Blake in Contrib. Gray Herb. n. s. **53**: 38. 1918.

ECUADOR: Prov. Azuay: dense moist forested slopes bordering Río Collay, on slopes called Huagrarancha, south of El Pan, alt. 2650–3290 m., *J. A. Steyermark 53393* (AA, Ch), July 6, 1950 (tree 30 ft. tall; leaves coriaceous, silvery green below with purplish rose midrib, above dark green; petals white, showy; sepals deep rose). — Moist dense cloud-forested slopes of Huagrarancha, 1.5 leagues south of El Pan, alt. 3140–3350 m., *J. A. Steyermark 53399* (AA, Ch), July 8, 1943 (tree 30 ft. tall, the wood good for construction purposes; flowers showy, the petals white). Prov. Loja: between Tambo Cachiyacu, La Entrada, and Nudo de Sabanillas, alt. 2500–3500 m., *J. A. Steyermark 54477* (AA, Ch), Oct. 7, 1943 (tree 30 ft. tall; flowers with odor of carrion, showy, the petals white, the filaments creamy white, the anthers yellow; leaves silvery green below). Prov. Imbabura: ridge of "El Corazon," above junction of Río Blanco and Quebrada Curiyacu, alt. 9400 ft., *W. B. Drew & I. L. Wiggins 11* (Ch), June 11, 1944 (tree to 20 m. or more; leaves shining green above, lighter and somewhat rusty beneath; flowers with odor of carrion, the petals waxy white, the sepals reddish; the anthers bright yellow).

COLOMBIA: Dept. Nariño: "entre El Encano y Pasto, vertiente occidental de La Cordillera, bosques residuales entre Páramo del Tábano y Laguna," alt. 2700–2900 m., *J. Cuatrecasas 11945* (US), Jan. 11, 1941 (tree; petals white; sepals green-rose). Dept. Cauca: West Andes of Popayan, on crest of mountain, in dense forest, alt. 2800–3200 m., *F. C. Lehmann 5130* (Ch, G, US), (tree up to 6 m. high with close erect crown of branchlets; leaves coriaceous, dark green, somewhat brittle; flowers milky white). — Mt. St. Ana, Cordillera Occidental, shrub-zone, alt. 2700–3000 m., *F. W. Pennell 7454* (G, NY, US), June 29, 1922 (tree with white petals). — Mt. El Derrumbo, Cordillera Occidental, shrub-zone, alt. 2700–3000 m., *F. W. Pennell 7487* (G, NY, US), June 29, 1922 (tree with white petals).

This variety was originally described by Moricand as *L. barbinervis* and was separated from *L. speciosa* by the glabrous calyx, the smaller leaves, and the concentration of pubescence at the apex of the under surface of the leaf, which is otherwise glabrous.

Among the specimens cited above, *Steyermark 53393* is the best example of true *L. barbinervis* as interpreted by Moricand. The calyx is quite glabrous except for an occasional patch of pubescence on some of the outer sepals. The leaves are somewhat smaller than those of the type of *L. speciosa,* and the tuft of pubescence is present at the apex of the leaf. On the other hand, *Steyermark 53399,* collected in the same general locality on the same day, agrees with *53393* in all respects except that the calyx is strikingly silvery appressed-pubescent, especially on the outer lobes. *Steyermark 54477,* collected in the Province of Loja at a slightly lower altitude, has larger leaves measuring as much as 5.5 × 2.2 cm., which

are equal to those on the type of *L. speciosa*. The calyx on some flowers in the last specimen is glabrous. On other flowers occasional pubescent spots are to be discerned.

These specimens of Steyermark are used in this discussion because of their excellent preparation and also because the region of their collection is close to the type-locality of *L. barbinervis*, which is Guayaquil, Ecuador.

The tuft of pubescence at the apex of the leaf is very striking in the specimens cited above. However, this character is not distinctive of the variety, since evidence of it may be found on most specimens of typical *L. speciosa* and on other species of the genus.

Having taken these variable characteristics into consideration, I do not think this entity worthy of specific distinction but merely a variety of typical *L. speciosa*.

The following discussion deals with the date of publication of *L. speciosa* Moricand, the clarification of which is not truly important as far as this genus is concerned but may be of importance for establishing the priority of the other species described at the same time.

According to Moricand, complete Latin descriptions of ten new species were prepared and *printed* in 1830 under the title "Plantae Americanae Rariores," but the actual publication of these species was abandoned because the engraver had not prepared the plates according to agreement. This statement, dated 1846, concerning the publication of the above-mentioned paper appeared in a foreword to Moricand's "Plantes Nouvelles d'Amérique," which was published during the years 1833–1846. This same series of plants appeared, also during the years 1833–1846, in Mém. Soc. Phys. Hist. Nat. Genève.

The original ten species were described in the following sequence: *Brongniartia intermedia, Laplacea barbinervis, Ternstroemia Ruiziana, Ternstroemia Pavoniana, Hibiscus tampicensis, Hibiscus Berlandierianus, Hibiscus lavateroides, Sida filiformis, Sida anomala* var. *mexicana,* and *Platanus mexicanus*.

Obviously, the 1830 publication got into distribution, since there is a copy, *complete with plates* and text, in the library of the Arnold Arboretum. Pritzel (Thesaurus, 1872) must have seen a copy of the original, since he lists the species in the order in which they appeared in the 1830 publication. I mention this sequence of the species since Moricand, as far as I know, never listed the ten original species in any of his publications. The sequence of the original ten species differs in the later publications. In Pl. Amer. Rar. (1830), *Laplacea barbinervis* was described as the second species and was represented by plate 2. In Pl. Nouv. Amér. (1836), the same entity was treated as the eleventh species.

Pritzel (Thesaurus, ed. 2, 224. 1872) refers to a short review of Moricand's Pl. Nouv. Amér. in Bot. Zeit. 1847: 475. 1847 by "S-l" (probably Schlechtendal), in which appears a German translation of the foreword of Moricand's 1846 publication. Checking this review of Schlechtendal, it should be noted that no listing of the original ten species was made. Yet Pritzel was able to record them — so he must have seen the original.

Also, Guillemin in Bull. Sci. Nat. et Geol. 23: 78. October 1830, the year of the original publication, reviews the earliest paper (1830) of Moricand and not only records (in order) the ten species but gives brief Latin descriptions of all of them. This in itself would constitute publication, and one must either accept the original date of Moricand or cite the ten species "Moricand ex Guillemin."

The vernacular names for this variety as recorded by Steyermark are: *pucanyahui, pucunllahui,* and *sumblid.*

5. **Laplacea acutifolia** (Wawra), comb. nov.

Laplacea semiserrata (Nees) Cambessedes var. *acutifolia* Wawra in Martius, Fl. Bras. **12**(1): 290. 1886.

Haemocharis acutifolia Martius ex Wawra in Martius, Fl. Bras. **12**(1): 290. 1886, in syn.

Haemocharis semiserrata (Nees) Martius & Zuccarini var. *acutifolia* (Wawra) Dusen in Archiv. Mus. Nac. Rio Janeiro **13**: 52. 1905.

Wikstroemia fruticosa Schrader var. *acutifolia* (Wawra) Blake in Contrib. Gray Herb. n. s. **53**: 39. 1918.

BRAZIL: Minas Geraes: Caldas, *A. F. Regnell "I 26¼"* (Ch, NY, US). — Sao Joao del Rey, Agua Geral-Serra do Lenheiro, *M. Barreto 4689* (AA, Ch), Aug. 8, 1936 (tree 0.5 m.). — *M. A. Glaziou 16709* (Mo, NY). St. Catherine: *Nadeaud s. n.* (Ch) in 1862. Precise locality lacking, *W. J. Burchell A550* (G) and *J. E. Pohl 2670* (Ch).

This species is characterized by narrow-elliptic or subelliptic membranaceous symmetrical leaves up to 10 cm. long, 2 cm. wide, acuminate at the apex, serrate on both margins, and quite glabrous on the under surface of the leaf.

The closest relationship is with *L. obovata,* which species differs in the obovate pubescent leaves, shorter as a rule and rounded to obtuse at the apex.

Formerly this species was associated with "L. semiserrata" by Wawra. Martius recognized it as a species under *Haemocharis* but had not published the combination. This combination first appeared as a synonym of *L. semiserrata* var. *acutifolia* in Wawra's studies.

6. **Laplacea spathulata,** spec. nov.

Arbor 20–30 metralis; ramulis teretibus, glabris, griseis. Folia in ramuli apice conferta, spathulata, membranacea, glabra vel glabrescentia, symmetrica, 7–9.5 cm. longa, 2.5–3 cm. lata, apice rotundata, basi longo-attenuata, supra nitida, subtus pallidiora, margine utrubique denticulata, ciliata, subrevoluta, venis 15–17 paribus, ad marginem anastomosantibus, petiolis brevissimis, ca. 3 mm. vel minus. Flores axillares, solitarii; pedicellis teretibus, 1–1.5 cm. longis, erectis vel recurvatis, adpresso-pubescentibus; sepalis 5, inaequalibus, concavis, suborbicularibus, undique pubescentibus, exterioribus ca. 8 mm. longis, 11 mm. latis, dense pubescentibus, margine angusto-membranaceis, interioribus ca. 12 mm. longis et 15 mm. latis, margine lato-membranaceis (ca. 5 mm.); petalis 5(–8), albis, obovatis, emarginatis, rare unguiculatis, inaequalibus, 2–3 cm.

longis, 1–2.6 cm. latis, dorso medio adpresso-pubescentibus; staminibus numerosis, ca. 3-seriatibus, 9–12 mm. longis, filamentis inaequalibus ca. 8–10 mm. longis, basi breviter connatis et petalis brevissime adnatis, antheris oblongis, ca. 2 mm. longis; ovario globoso, ca. 4 mm. diametro, dense sericeo, 5-angulato, 5-loculato, loculis pauci-ovulatis, stigmatibus 5.

PERU: Dept. Loreto: Mishuyacu, near Iquitos, in forest, alt. 100 m., *G. Klug 383* (C, US), Oct.-Nov. 1929 (tree 15 m. high with white flowers). — Mouth of Rio Santiago, on high land, *G. Tessman 4592* (NY) (tree 30 m.).

BRAZIL: Amazonas: basin of Rio Negro (Rio Tikie), *R. Froes 228* (Arnold Arboretum, TYPE; NY), April 29, 1942 (tree 70 ft. high).

The truly spathulate symmetrical leaves, denticulate on both margins with long tapering base and rounded apex, set this distinctive species apart from other known species in this region. By some workers two of the collections (*Tessmann 4592* and *Klug 383*) have been identified with "*L. quinoderma* Wedd." However, the latter species (now a synonym of *L. pubescens*) is quickly separated by the larger acuminate leaves which are densely pubescent and rough to the touch and less conspicuously tapering at the base.

The petals in *L. spathulata* vary considerably in a single flower, ranging from symmetrical obovate to broadly obovate unguiculate. Following are the measurements in centimeters of eight petals taken from one flower: 2 × 1, 2 × 1.2, 2.5 × 1, 2.5 × 1.5, 2.5 × 1.5, 2.8 × 1.2, 3 × 1.3, 2.5 × 2.6. All are emarginate. Only one petal (2.5 × 2.6) was truly unguiculate.

The concave sepals vary in like manner, especially in the membranaceous margin. The margin of the outer sepals is membranaceous for a distance of only a single millimeter. The width of the membranaceous part of the margin varies until in the inner sepal it may be as much as 4–5 millimeters.

This species may extend into Venezuela. A sterile specimen collected by *H. N. Whitford*, no. *38*, and deposited at the Gray Herbarium, probably belongs here. The tapering at the base of the leaf is more abrupt and less tenuous than in the specimen cited above.

7. **Laplacea obovata** (Wawra), comb. nov.

Laplacea semiserrata (Nees) Cambessedes var. *obovata* Wawra in Martius, Fl. Bras. **12**(1): 290. 1886.

Haemocharis obovata Martius ex Choisy in Mém. Soc. Phys. Hist. Nat. Genève **1**: 144 (Mém. Ternstr. 56). 1855, as syn.

Wikstroemia fruticosa Schrader var. *obovata* (Wawra) Blake in Contrib. Gray Herb. n. s. **53**: 39. 1918.

BRAZIL: Minas Geraes: *C. F. Martius 833* (Ch, Mo, NY), *1062* (NY), in 1841. — *P. Claussen 73* (NY), *454* (G), *s. n.* (G). — *F. Sello 4037*, in part (US). Precise locality lacking, *J. E. Pohl s. n.* (Ch); *F. Sello s. n.* (US); *E. Warming s. n.* (US).

This species is characterized by symmetrical membranaceous leaves,

obovate, obtuse to rounded at the apex, occasionally bluntly acuminate, pubescent on the under surface with striae of pubescence running parallel to the midrib, denticulate at the margin on both edges, and with ca. 10 pairs of veins distinct on the lower surface.

The leaves measure 6–8 cm. long and 2–3 cm. wide. On *Martius 833* smaller leaves are found which measure 4 × 1 cm. However, on the same specimen are found leaves measuring 6 cm. long and 2 cm. wide. Two species are represented on *Sello 4037*, namely *L. obovata* and *L. fruticosa*.

This species is closely related to *L. tomentosa,* which can be separated readily by the heavy coriaceous leaves, densely dark-tomentose beneath with no evidence of veins.

This species was originally described by Wawra as a variety of "*L. semiserrata*." The symmetrical leaves, denticulate on both edges, show that it is more closely related to *L. tomentosa*.

8. **Laplacea pubescens** Planchon & Linden ex Triana & Planchon in Ann. Sci. Nat. sér. 4, **18**: 269. 1862. — Walpers, Ann. Bot. 7: 367. 1868. — Melchior in Nat. Pflanzenfam. ed. 2, **21**: 136. 1925.

Haemocharis pubescens (Planchon & Linden) Linden & Planchon, Trois. Voy. Linden. [Bot. Pl. Columb.] **1**: 59. 1863 [repr. in Kew Bull. **1926**: 43. 1926].

Laplacea quinoderma Weddell, Hist. Nat. Quinquinas 33, 1849 (footnote). — Melchior in Nat. Pflanzenfam. ed. 2, **21**: 136. 1925.

Haemocharis quinoderma (Weddell) Choisy in Mém. Soc. Phys. Hist. Nat. Genève **1**: 145 (Mém. Ternstr. 57). 1855. — O. Kuntze, Rev. Gen. Pl. **1**: 62. 1891. — Szyszylowicz in Nat. Pflanzenfam. III. **6**: 185. 1893.

Wikstroemia pubescens (Planchon & Linden) Blake in Contrib. Gray Herb. n. s. **53**: 40. 1918.

Wikstroemia quinoderma (Weddell) Blake in Contrib. Gray Herb. n. s. **53**: 40. 1918.

COLOMBIA: Santander del Norte: near Pamplona, alt. ca. 2000 m., *N. Funck & L.-J. Schlim 1454* (ISOTYPE, Ch; photo, AA, Ch), June 1847 (flowers white, in February). — Sierra de Ocana, forest at summit, alt. ca. 2000 m., *H. H. Smith 2510* (Ch, G, Mo, NY, US), Aug. 25, 1898 (tree 25–30 ft.).

BOLIVIA: Tumupasa, alt. ca. 1000 m., *R. S. Williams 411* (NY, US), Jan. 4, 1902 (tree 20 ft. high with white flowers turning pink). — Hacienda Simaco sobre el camino a Tipuani, alt. ca. 1400 m., *O. Buchtien 5463* (US). — Dept. La Paz, Prov. Larecaja, Copacabana (about 10 km. south of Mapiri), alt. 850–950 m., *B. A. Krukoff 11064* (AA, Ch, Mo, NY), Oct.-Nov. 1939 (tree ca. 30 m. high). — Yungas, alt. ca. 2000 m., *H. H. Rusby 627* (NY).

PERU or BOLIVIA: exact locality uncertain, *H. A. Weddell s. n.* (TYPE of *L. quinoderma,* fragm. & photo, Ch).

The characters which distinguish this species are: (1) obovate, symmetrical leaves (to 10 × 4 cm.), obtuse or nearly so at the apex, denticulate along the margin on both sides; (2) dense tawny pubescence on the external surface of the corolla and calyx, ovary and fruit, pedicel, under surface of the leaves, and young branchlets; and (3) short (0.5–1 cm. long) pedicel, often recurved.

The extent and the density of the pubescence varies in the specimens cited above. *Funck & Schlim 1454* and *Krukoff 11064* possess the densest and most typical pubescence, which extends down the branchlets. In some specimens a tendency toward glabrescence exists, but these latter are also less pubescent when very young. Most leaves show striking striae of pubescence running nearly parallel to the midrib, caused probably by the original folds in the leaves.

Here also belongs *L. quinoderma* Weddell, so obscurely described in a footnote in Hist. Nat. Quinquinas. Early in this study I planned to distinguish this entity from *L. pubescens*. However, in preparing the key to the species, I could find no characters sufficiently definite to warrant a separation of the two.

8a. **Laplacea pubescens var. subcaudata, var. nov.**

A specie differt foliis longioribus, 10–15 cm. longis, ca. 4 cm. latis, apice subcaudatis, juventute dense sericeis, maturitate plus minusve glabrescentibus.

PERU: Pampayacu, *E. Poeppig 1597* (fragm. & photo, Ch). — Precise locality unknown, *L. H. Ruiz s. n.* (TYPE, Ch). — Locality unknown, *L. C. Ruiz s. n.* (Ch, photo no. 9750).

BOLIVIA: Yungas, *A. M. Bang 385* (Ch, Mo, NY, US) in 1890.

The type of this variety was identified by Melchior as "*L. quinoderma*" (*L. pubescens*), and it is with that entity that it should be associated. However, the species is characterized by smaller leaves quite obtuse at the apex, with only an occasional blunt acumen. In the present new variety the apex of the leaf is characterized by an elongated acumen which gives it an appearance quite distinct from that of *L. pubescens* itself. However, I do not consider it worthy of specific distinction.

8b. **Laplacea pubescens** var. **camelliaefolia** (Triana & Planchon), comb. nov.

Laplacea camelliaefolia Triana & Planchon in Ann. Sci. Nat. sér. 4, **18**: 270. 1862. — Walpers, Ann. Bot. **7**: 367. 1868. — Melchior in Nat. Pflanzenfam. ed. 2, **21**: 136. 1925.

Laplacea cameniaefolia Hooker & Jackson, Index Kew. **2**: 30. 1894, *sphalm.*

Wikstroemia camelliaefolia (Triana & Planchon) Blake in Contrib. Gray Herb. n. s. **53**: 39. 1918.

COLOMBIA: Dept. Santander del Norte: road from Pamplona to Toledo, crossing the divide between Río La Teja (Maracaibo drainage) and Río Mesme (Orinoco drainage), thickets along stream, alt. 2500–2800 m., *E. P. Killip & A. C. Smith 19822* (AA, Ch, G, NY, US), Feb. 28, 1927 (tree 10–12 ft.; petals white).

VENEZUELA: Tachira: between Paraguita and Tabor, along Río Tachira, along Colombian-Venezuelan boundary, alt. 1820–1980 m., *J. A. Steyermark 57151* (AA, Ch), July 12, 1944 (small tree 25 ft. high; petals whitish). — Between Villapaez and Betania, along Río Tachira, near Colombian-Venezuelan boundary, alt. 2130–2285 m., *J. A. Steyermark 57163* (AA, Ch), July 12, 1944 (tree 30 ft. high; petals white). — Woods above Betania

below Páramo de Tamá, alt. 2530 m., *J. A. Steyermark 57436* (AA, Ch), July 17, 1944 (tree 40 ft. high; petals white).

This variety is separated from the species mostly on the degree of pubescence. When comparing the material cited above with the type of the species one may readily see why Triana & Planchon designated them as two species at the time. The type of the species is much more densely pubescent. Also the leaves on the variety show a tendency toward an acuminate apex, perhaps to a more marked degree than material of the species.

This variety seems to have been collected at higher altitudes than the species, generally ranging from 2000–2500 meters. Steyermark records the vernacular name *tampacillo* for his collection numbered *57163*.

9. **Laplacea tomentosa** (Martius & Zuccarini) G. Don, Gen. Syst. **1**: 569. 1831. — Walpers, Repert. Bot. Syst. **1**: 372. 1842. — Wawra in Martius, Fl. Bras. **12**(1): 291. 1886. — Melchior in Nat. Pflanzenfam. ed. 2, **2**: 136. 1925.

Haemocharis tomentosa Martius & Zuccarini, Nov. Gen. et Sp. **1**: 108, *t. 67.* 1826. — Choisy in Mém. Soc. Phys. Hist. Nat. Genève **1**: 145 (Mém. Ternstr. 57). 1855. — O. Kuntze, Rev. Gen. Pl. **1**: 62. 1891. — Szyszylowicz in Nat. Pflanzenfam. III. **6**: 185. 1893.

Gordonia tomentosa (Martius & Zuccarini) Sprengel, Syst. Veg. Cur. Post **4**(2): 260. 1827.

Laplacea tomentosa var. *glabrata* Wawra in Martius, Fl. Bras. **12**(1): 291. 1896.

Wikstroemia tomentosa (Martius & Zuccarini) Blake in Contrib. Gray Herb., n. s. **53**: 41. 1918.

Wikstroemia tomentosa var. *glabrata* (Wawra) Blake in Contrib. Gray Herb. n. s. **53**: 41. 1918.

BRAZIL: Minas Geraes: Ouro-Preto, *A. Glaziou 14527* (NY). — Santa Barbara, Serra de Caraça, among rocks, *M. Barreto 7228* (Ch), April 15, 1933 (tree 8 m. high). — *P. Claussen 1520* (Ch, NY), in 1841. — *L. Riedel 2623* (G). — *C. F. Martius s. n.* (G), in 1841.

This species is characterized by thick coriaceous symmetrical leaves 6–8 cm. long and ca. 3 cm. wide, rounded to obtuse at the apex, thick-tomentose beneath with accented lines of pubescence running nearly parallel to the midrib, the margin somewhat revolute, denticulate along both sides, the veins obscure.

Closely related and from the same general locality is *L. obovata*. This latter species can be separated from *L. tomentosa* by the membranaceous or submembranaceous texture of the leaves, the glabrescent character of the pubescence, and the evidence of veins.

From the material examined, *L. tomentosa* appears to be quite localized in the state of Minas Geraes.

Wawra distinguished a variety *glabrata* which here has been included in the species. There is a tendency toward glabrescence in the mature leaves of all the material of this species.

LITTLE-KNOWN OR DOUBTFUL SPECIES

LAPLACEA RAIMONDIANA Melchior in Nat. Pflanzenfam. ed. 2, 21: 136. 1925.

This species was proposed by Melchior in his treatment of the Theaceae in the above publication. No formal description was presented, but the name was offered in the key to the South American species. From the headings of the key, one finds that *L. Raimondiana* may be characterized by somewhat coriaceous, asymmetrical, oblong leaves, more or less blunt at the apex, emarginate, pubescent underneath, the margin entire. The flowers are recorded as large. The species is from Peru, and the type is *Weberbauer 2291*. A photograph of this species is in the herbarium of the Chicago Natural History Museum.

According to my own key above, this species would fall into *L. fruticosa* var. *symplocoides* because of the asymmetrical leaves with entire margin — and it is here that I believe it belongs. However, the photograph of the type shows that nearly all the leaves were folded in pressing the specimen, thus making a definite decision on the status of this species quite impossible. Unfortunately, the type was deposited in the Berlin Herbarium, which was for the most part destroyed during the past war.

ARNOLD ARBORETUM,
HARVARD UNIVERSITY.

THE ARNOLD ARBORETUM DURING THE FISCAL YEAR ENDED JUNE 30, 1950

Horticulture. — The collections of living trees and shrubs have been maintained in good condition in spite of dry weather during the summer of 1949. In addition to the usual pruning operations the oak collection and the rhododendrons on Hemlock Hill were thinned. The Centre Street path has been completely renovated, and the Buxus collection has been assembled in a more favorable site. More than 12 tons of commercial fertilizer were used in a program designed to promote better growth of the trees and shrubs. The soil improvement project on Peters Hill is progressing satisfactorily. Weed trees and poison ivy are perennial problems, but chemical weed control is making progress.

Doctor Wyman is making a survey of all varieties of desirable ornamental woody plants in order to make our collections as complete as possible. Approximately 350 varieties were obtained from 105 different nurserymen for purposes of trial, study and display. More than 300 plants of new varieties from the Arboretum were distributed to commercial growers who specifically requested them. Several hundred of our new apple and cherry hybrids were distributed to Friends of the Arnold Arboretum. Our propagator, Mr. Fillmore, sent 1054 species and varieties of woody plants to cooperating institutions in 13 countries. He received 890 species and varieties from various sources in 15 different countries. He propagated, by cuttings, grafts, or seeds, a total of 8,200 plants.

The photographic records, especially of rare or unusual plants, is one of the responsibilities which has been neglected in the past. New equipment and other photographic facilities have enabled Mr. Howard to add 1500 pictures to the collections during the past year. These are in addition to the Kodachrome slides made to illustrate the lectures given by Dr. Wyman.

The Case Estates permit testing of new material on a much larger scale than was possible at the Arnold Arboretum in Jamaica Plain. The test nurseries contain nearly 2000 different species or varieties of woody plants, some of them introduced directly from Europe. A Post-entry Quarantine Nursery is cared for at the Case Estates, under the observation of the U.S.D.A. Bureau of Plant Quarantine. A ground cover test plot includes 70 different kinds of woody and herbaceous ground covers. Several acres of land are used for testing hybrid poplars developed under the auspices of the Cabot Foundation. The Division of Landscape Architecture of Harvard continues its experimental laboratory on the premises.

The educational work of the Arnold Arboretum has continued with the usual number of issues of Arnoldia, our journal of popular information. The Field Class was given by Dr. Wyman, who also delivered a number of lectures in many parts of the United States, including a series at the Colonial Williamsburg Symposium.

The experimental work of the Arnold Arboretum includes extensive work on propagation by Mr. Fillmore. He has also done some work with growth suppressing chemicals in connection with propagating problems. The director has continued his work with dwarfing rootstocks and altered polarity to produce dwarf trees. The breeding program has shown the value of triploids in ornamental plants. The radiation work, done under the auspices of A.E.C., has shown that plants can be subjected to several roentgens of ionizing radiation per day for months without serious injury.

Comparative Morphology. — During the year Professor Bailey and his co-workers have completed their investigations of a number of dicotyledonous families. The most comprehensive of these is a detailed study of the Monimiaceae including a suggested revision of the family. Mister R. W. Vander Wyk presented a thesis, dealing with the comparative morphology of the Annonaceae, for the doctorate which he received in June. Doctor Swamy, with his prodigious drive and efficiency, not only completed investigations of the comparative morphology of the Santalaceae, Gomortegaceae, Calycanthaceae, Saururaceae and Chloranthaceae, but also undertook a taxonomic revision of the last family.

The Herbarium. — During the year 10,775 mounted specimens were added to the herbarium, bringing the total to 656,545 specimens. A total of 16,493 specimens were received, of which 2,115 were obtained for identification, 8,424 by exchange and 5,604 by purchase or subsidy. The greater part of these accessions represent plants of the Old World, namely 4,687 from southern and eastern Asia, and 6,748 from Malaysia, Micronesia and Polynesia. Among the accessions of particular interest may be mentioned 1,585 specimens from Japan received from Dr. H. Hara, S. Suzuki and K. Uno, 1,900 East Indian plants from the Botanic Garden of Buitenzorg, 403 Indo-Chinese plants from A. Pételot, 1,325 specimens from Bombay Presidency, India, from Father H. Santapau, 1,230 specially selected Philippine plants from Dr. E. Quisumbing, 172 duplicates of Beccari's classic Malaysian plants from the Botanical Institute, Florence, Italy, and 290 of his very beautifully prepared and critically identified Chinese plants from Dr. H. H. Smith of Uppsala.

A total of 33,487 herbarium specimens were sent out during the year. Of these 10,840 were transferred to the Gray Herbarium and 610 (all orchids) to the Ames Orchid Herbarium. Duplicates totalling 4,891 were sent in exchange to institutions in the United States, and 17,146 specimens were sent to foreign institutions.

From 24 different institutions the Arboretum had 33 requests for the loan of its herbarium material. Specimens involved numbered 2,924, of which 1,841 went to thirteen American institutions and 1,083 to eleven foreign. For the use of our staff in research, 34 lots of herbarium specimens were borrowed for study. These consist of 941 specimens borrowed from five American, and 1,131 specimens from nine foreign herbaria.

Doctor Merrill had as his major project the identification of recent collections made in the Philippines. Doctor Johnston, having decided to

change his field from American to Asiatic botany, as a transition, worked on an account of the Boraginaceae of eastern Asia. Doctor Kobuski is concluding his studies in the American material of the troublesome, poorly understood family Theaceae. In the future he also intends to work, for the most part, on the Asiatic flora. Doctor Perry has worked on plants from New Guinea and has completed some special studies in the Myrtaceae. Doctor Shiu-ying Hu began her work as a staff member and as a specialist on the flora of China.

During the year the large store of unmounted specimens was examined methodically and appraised. Where possible the more valuable material was selected for mounting and that of little direct use to the Arboretum was set aside for use in exchange. Several large oriental collections, for the time being best kept unmounted, were sorted and stored in systematic arrangement and thus made readily available for study. The storeroom, however, still contains a great mass of collections and duplicates which can be processed only after the specimens are identified. The naming of this material should be a project of the herbarium staff during the next few years.

With the death of Alfred Rehder on July 21, 1949, the Herbarium lost a very distinguished member of its staff. The Herbarium, in many ways, is his monument. Under his administration and because of his studies, the collection grew from a few thousand sheets to the present large one of great reference value and international reputation.

The Library. — Three hundred and nine volumes were added to the library during the fiscal year ended June 30, 1950, making a total of 47,343 bound volumes. There were 287 pamphlets catalogued and filed, 604 cards were added to the main catalogue and 3,099 to the Gray Herbarium new species cards.

The inter-library loan service grows and grows; 518 books were either loaned or borrowed; loans to the business office for photostat or microfilm work were especially heavy.

Over 800 photographs taken by the horticultural staff were added to the photograph collection.

Financial report. — The Arnold Arboretum received during the year $10,000 from the Fanny P. Mason bequest, and $15,841 from the Louisa W. Case estate. These funds were added to endowment. Gifts for current use included $8,159 from the Friends of the Arnold Arboretum and $1,540 from other sources.

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KARL SAX,
Director.

Staff of the Arnold Arboretum

1949 — 1950

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IVAN MURRAY JOHNSTON, Ph.D., Associate Professor of Botany and Associate Director. Supervisor of the Library and Herbarium.

JOSEPH HORACE FAULL, Ph.D., Professor of Forest Pathology, Emeritus.

ELMER DREW MERRILL, S.D., LL.D., Arnold Professor of Botany, Emeritus.

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LAZELLA SCHWARTEN, Librarian.

FRANS VERDOORN, Ph.D., Research Fellow.

ROBERT GEROW WILLIAMS, B.S., Superintendent.

DONALD WYMAN, Ph.D., Horticulturist.

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